Wastewater Treatment Plant Nutrient Study Update

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City of Emporia, Kansas

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1.0 Introduction

A. Study Objective

The City of Emporia operates a publicly owned wastewater treatment facility (WWTF) which processes all of the wastewater flows from the City. Some of the most recent improvements were designed to comply with effluent limitations on BOD, ammonia, fecal coliform and dissolved oxygen and to improve system redundancy. The permitted capacity of the WWTF is 4.6 million gallons per day (MGD).

The City's current National Pollution Discharge Elimination System (NPDES) permit requires completion of a feasibility study for the WWTF to comply with proposed Total Nitrogen (TN) and Total Phosphorus (TP) effluent limits. This report will examine the capabilities of the existing plant processes and analyze alternatives for achieving nutrient removal.

B. Scope of Study

A study was prepared in 2010 as a condition of the City's NPDES permit at that time. That study examined the capabilities of the existing WWTF processes and analyzed alternatives for achieving three levels of nutrient removal: Biological Nutrient Removal (BNR), Enhanced Nutrient Removal (ENR), and Current Limits of Technology (LOT).

The City's current NPDES permit became effective on May 1, 2013 and now includes a goal of achieving target effluent levels of < 10.0 mg/L Total Nitrogen and < 1.0 mg/L Total Phosphorous. This study will update information from the previous study, and evaluate the existing WWTF's ability to address the new treatment goals of < 10.0 mg/L Total Nitrogen and < 1.0 mg/L Total Phosphorous.

2.0 Regulatory Analysis

A. Permit Requirements

1. Existing NPDES Permit Requirements

The City of Emporia was issued NPDES permit No. M-NE24-I001 (Federal Permit No. KS000046728) for their existing WWTF and discharge point into the Cottonwood River. It became effective on May 1, 2013 and identifies effluent limitations, monitoring requirements, and other conditions for wastewater discharge from the existing WWTF. There are specific weekly and monthly average limits for BOD, TSS and E.coli, and specific monthly average and maximum daily limits for effluent ammonia. The current permit will expire on April 30, 2018.

2. Nutrient Loading

The current average effluent concentrations for ammonia, nitrogen, and phosphorus are shown in Table 1.

Table 1: Average Effluent N and P Concentrations

Parameter	Value (mg/L)
Ammonia-Nitrogen (NH3-N)	1.54
Total Nitrogen (TN = Nitrite + Nitrate)	27.61
Total Phosphorus (TP)	7.51
Total Kjeldahl Nitrogen (TKN)	3.63

At Emporia's current rated capacity of 4.6 MGD, the total maximum pounds of nutrients that could be discharged daily from the facility under the goal limit concentrations of 10 mgk TN and 1.0 mgk TP are an average of 384 pounds per day (ppd) of nitrogen and 38 pounds per day (ppd) of phosphorous.

It should be noted that currently the facility is discharging an average of 465 ppd of nitrogen and 113 ppd of phosphorus.

B. Current Water Quality Standards

The discharge of wastewater into receiving waters must be managed to protect pub-lic health, maintain water quality, and comply with federal and state requirements. The Kansas Water Quality Standards are used by the KDHE in the development of permit conditions for the National Pollutant Discharge Elimination System (NPDES) program. These conditions determine the degree, and often the type, of wastewater treatment necessary. The quality of effluent discharged is controlled by designated stream classification, in-stream water quality standards, and resultant discharge permit limits.

In the State of Kansas, pollution control of surface waters is governed through Kansas Administrative Regulations (K.A.R.) 28-16-28b through 28-16-28g. The in-tent of these rules is to protect and improve the quality of surface water for human consumption, wildlife, fish and other aquatic life, industry, recreation, and other production and beneficial uses. The KDHE has been designated as the responsible governmental unit for implementing this program.

K.A.R. 28-16-28b through 28-16-28g set standards for in-stream water quality through designated use classifications. The classifications summarized in Table 2 have been established by the State of Kansas.

Table 2: State of Kansas Water Classifications

Classification	Designated Use
Agricultural Water Supply	Irrigation Livestock watering
Aquatic Life Support	Special - threatened or endangered species Expected - habitat type and indigenous biota commonly found or expected in the state Restricted - indigenous biota limited in abundance or diversity by the physical quality of the habitat
Domestic Water Supply	Production of potable water
Food Procurement	Aquatic or semi-aquatic life for human consumption
Groundwater Recharge	Replenishing groundwater
Industrial Water Supply	Non-potable uses by industry
Recreational	Primary Contact Recreation - body immersed, probable ingestion Secondary Contact Recreation - ingestion not probable

1. Kansas Discharge Permitting System

The NPDES permit is enforced by the State of Kansas through the KDHE. This system requires that effluent discharge permits be obtained for all point sources discharging wastewater into state waters. A point source is defined as "any discernible, confined, and discrete conveyance from which pollutants are or may be discharged" (U.S. EPA, 1983). Pollutants to be regulated include liquid and solid wastes of chemical, biological, or physical nature, which are discharged into surface waters. The NPDES permit is typically renewed every five years.

An effluent discharge permit issued under NPDES includes two main elements: specific effluent limits for each regulated pollutant being discharged, and effluent monitoring requirements.

Effluent limits in Kansas NPDES permits reflect two levels of treatment requirements. The first level, referred to as technology-based limits, is based on technological treatment capabilities and provides the minimum degree of treatment required before discharge. The second level of treatment requirements, termed water-quality-based effluent limits, may be imposed on municipal and industrial dischargers if technology-based limits are insufficient to protect and maintain designated water uses. These water-quality-based limits are defined by total maximum daily loads (TMDLs), which are the maximum quantities of pollutants that can be carried by a receiving water without adversely affecting water uses (Federal Water Pollution Control Act, 1972). The TMDLs are proportioned among dischargers on a given river segment through a waste load allocation procedure (U.S. EPA, 1983).

Kansas and federal law also require an anti-degradation review be performed for a new discharge, or a change in discharge that would increase the mass of pollutants to the receiving stream. The review must determine whether the discharge will cause the water quality of the stream to be lowered below the quality necessary to support its existing designated uses.

C. Biosolids Regulatory Framework

The final 40 CFR Part 503 regulations were published in February, 1993. The major requirements which affect the City of Emporia for use and disposal of sewage sludge include:

- Land application
- Pathogen reduction (Class A and Class B)
- Vector attraction reduction
- Permits

These requirements are briefly outlined below.

1. Land Application

Biosolids application to agricultural and non-agricultural land, reclamation sites, public contact sites, and home lawns and gardens is limited by the pollutants in the biosolids. Biosolids must be applied at agronomic rates not to exceed the plant nitrogen requirements established by the State. However, phosphorus application rates may control land application availability in the future and make disposal in a permitted landfill more attractive.

Table 3 lists the federal pollutant limits. These limits are applied to land application as follows:

- All biosolids for land application must be less than the Pollutant Ceiling Concentration and the Cumulative Pollutant Loading.
- Biosolids applied to lawns and gardens must meet the Alternate Pollutant Concentration.
- Biosolids given away or sold to the public must meet the Alternate Pollutant Concentration, or the Annual Pollutant Loading.

Table 3: Land Application Pollutant Limits

Pollutant	Pollutant Ceiling Concentration, mg/kg	Cumulative Pollutant Loading, kg/ha	Alternate Pollutant Concentration "EQ sludge", mg/kg (Monthly Average)	Annual Pollutant Loading Rate. Limits for APLR Biosolids kg/ha/yr
Arsenic	75	41	41	2.0
Cadmium	85	39	39	1.9
Copper	4,300	1,500	1,500	75
Lead	840	300	300	15
Molybdenum	75			
Mercury	57	17	17	0.85
Nickel	420	420	420	21
Selenium	100	100	100	5.0
Zinc	7,500	2,800	2,800	140

Notes:
1. 1 ton = 900 kg
2. 1 acre = .4047 hectares
3. mg/kg - milligrams per kilogram
4. kg/ha - kilograms per hectare

2. Pathogen Reduction

Class A and Class B pathogen reduction requirements for land application are established by the Part 503 regulations. Class A pathogen reduction is required for public distribution and for lawns and gardens. All other land application methods require Class B pathogen reduction although significant site restrictions will apply to Class B land application.

Class A: Either 1,000 most probable number (MPN) fecal coliform per gram total dry solids, or 3 MPN salmonella per 4 grams total dry solids, and one of the following:

- Thermally Treated Biosolids – Biosolids must be subjected to one of four time-temperature regimes.
- Biosolids Treated in a High pH – High Temperature Process Biosolids must meet specific pH, temperature, and air drying requirements.
- Biosolids Treated in Other Processes – Process must demonstrate reduction of enteric virus and viable helminth ova. Maintain operating conditions used in the demonstration after pathogen reduction demonstration is complete.
- Biosolids Treated in Unknown Process – Biosolids must be tested for pathogens – Salmonella sp. or fecal coliform bacteria, enteric viruses and viable helminth ova at the time the biosolids are used or disposed, or, in certain situations, prepared for use or disposal.
- Biosolids Treated in a PFRP – Biosolids must be treated in one of the following Processes to Further Reduce Pathogens (PFRP):

- Composting
- Heat treatment
- Heat drying
- Thermophilic aerobic digestion
- Pasteurization
- Beta ray irradiation
- Gamma ray irradiation

- Biosolids Treated in a Process Equivalent to a PFRP – Biosolids must be treated in a process equivalent to one of the other PFRPs as determined by the permitting authority.
- Class B: 2,000,000 MPN fecal coliform/gram total dry solids and one of the following Processes to Significantly Reduce Pathogens (PSRP):

  - Anaerobic digestion
  - Aerobic digestion
  - Air drying
  - Composting
  - Lime stabilization
  - Other PSRP equivalent process

3. Vector Attraction Reduction

This requirement addresses the stabilization of biosolids prior to disposal to reduce attraction of flies, mosquitoes, fleas, rodents, and birds, and requires one of the following processes to achieve this stabilization.

- Reduce the mass of volatile solids by a minimum of 38%
- Demonstrate vector attraction reduction with additional anaerobic digestion in a bench scale unit.
- Demonstrate vector attraction reduction with additional aerobic digestion in a bench scale unit.
- Meet a specific oxygen uptake rate for aerobically treated biosolids.
- Use aerobic processes at greater than 40oC for 14 days or longer (e.g. during composting)
- Add alkaline materials to raise the pH under specific conditions.
- Reduce the moisture content of biosolids that do not contain unstabilized solids from other than primary treatment to at least 75% solids.
- Reduce moisture content of biosolids with unstabilized solids to at least 90%.
- Inject biosolids beneath the soil surface within a specific time, depending on the level of pathogen treatment.
- Incorporate biosolids applied to or placed on the land surface within specified time periods after application to or placement on the land surface.

4. Permits

The Part 503 regulations require permits for all wastewater plants generating biosolids. The permit application is required six months before the expiration of the existing NPDES permits for the treatment plant. The information required for a permit application includes:

- Biosolids monitoring data and annual volumes.
- Available groundwater monitoring data for landfills or land application sites.
- Description of biosolids use or disposal practices including location of application or disposal sites, contractors who apply biosolids, and distributors who market biosolids.
- A land application plan for each site including:
    - Geographical area covered by plan.
    - Site selection criteria.
    - How the site will be managed.
    - Advance notice to permitting authorities, adjacent landowners and occupants, and to the public (if required by the State).

D. Additional Applicable Regulations

Wastewater treatment and biosolids handling can also be affected by additional laws and regulations, as described below.

1. Proposed Sanitary Sewer Overflow (SSO) Regulations

The EPA signed a notice of proposed rulemaking on January 4, 2001 concerning overflow occurrences from municipal sewer collection systems (40 CFR Parts 122 and 123). As of January 20, 2001, the document was withdrawn from the Office of the Federal Register to give the new EPA administrator an opportunity to review it. The fundamental purpose of the proposed rules is to recognize the fact that sanitary sewer overflows present important concerns for public health and the environment.

In general, the proposed regulations prohibit any sanitary sewer system discharges prior to the headworks of a publicly owned treatment works (POTW) facility, unless it can be proven that the discharge was caused by severe natural conditions or was unavoidable despite proper management, operation and maintenance of the system. The proposed regulations would be enforced through the jurisdiction of the NPDES permitting process.

2. Proposed Policy NPDES Permit for Peak Wet Weather Discharges

The EPA provided notice on December 22, 2005 to invite public comment on a draft policy regarding NPDES permit requirements for peak wet weather discharges from a POTW serving separate sanitary sewer collection systems.

History - A previous interpretation on the issue was released for public comment on November 7, 2003. EPA's proposed action was not a rule change. Blending is a longstanding wastewater treatment practice that predates the 1972 Clean Water Act. It involves routing excess primary treated flows around secondary (biological) treatment processes, and combining them with secondary treated flows before discharging it to the environment. It is used to keep the microbes in biological processes from being washed away during severe storms and snowmelts. If that happens, treatment plant staff must wait several weeks for a new colony of microbes to mature before wastewater can receive full secondary treatment again.

EPA received significant public comment on the proposed policy, and retracted that document. As a result of this retraction the Natural Resources Defense Council (NRDC) and the National Association of Clean Water Agencies (NACWA) provided EPA with a joint proposal recommending an approach significantly different than the November 2003 proposal. The December 22, 2005 draft policy invites comments on this second interpretation.

Draft Policy - This document provides extensive comment on the Agency's interpretation of 40 CFR 122.41(m), the bypass regulation. This policy: (1) interprets 40 CFR 122(m)(4) as it applies to peak wet weather flow diversion around secondary treatment units at POTW treatment plants serving separate sanitary sewer systems where the flow is recombined with the plant effluent before discharge, (2) interprets 40 CFR 122.41(m)(4)(i)(B) as no feasible alternatives, (3) does not apply to overflows prior to the headworks of a POTW, dry weather diversions, diversions around primary or tertiary units, or diverted flow that is not recombined with effluent from secondary units prior to discharge; (4) promotes the use of measures to provide the highest possible treatment to the greatest possible peak wet weather flow; and (5) promotes reporting and public notification of peak wet weather diversion events. A combination of approaches can be used to achieve compliance with this policy: (1) ensure full utilization of available secondary treatment capacity, (2) reduce Infiltration/Inflow (I/I), (3) maximize the use of the collection system for storage, (4) provide off-line storage, and (5) provide sufficient secondary treatment capacity.

In order to avail itself of this policy the POTW treatment plant serving a separate sanitary sewer collection system needs to submit a "No Feasible Alternatives Analysis" to the NPDES permitting authority at the time of the next NPDES permit renewal. For a POTW operator that is applying for a peak wet weather flow diversion at a treatment plant as an anticipated event the analysis must include: (1) documentation of the current treatment plant treatment unit design, maximum flow capacities, and the feasibility of increasing the flow through the units, (2) estimates of the frequency, duration, and volume of current wet weather diversions, and evaluations of alternatives to reduce the frequency, duration and volumes of such occurrences with related costs, (3) estimates of future diversions based on weather predictions, population growth, and treatment plant changes, and evaluations the options for reducing the flow diversions, (4) assessment of other ways to reduce peak wet weather volumes, (5) evaluation of different technologies that are or could be used to provide additional treatment to peak wet weather diversions at the POTW and the costs of implementing these techniques, (6) assessment of the extent to which the permitee is maximizing its ability to reduce I/I in its own collection system, including an evaluation of the surrounding satellite municipal collection systems, (7) evaluation of the peak flow reductions possible through the implementation of a Capacity, Management, Operation & Maintenance (CMOM) program, (8) addressing the ability of the community served to fund the peak wet weather flow improvements discussed in the analysis, and proposing a protocol for monitoring the recombined flow at least once daily during all diversions, and (9) projecting the POTW effluent improvements and other improvements in the collection system should the technologies, practices and/or other measures be implemented as discussed in the analysis.

3. Kansas Department of Health and Environment Minimum Standards of Design

The KDHE provides Minimum Standards of Design for Water Pollution Control Facilities. These documents cover most aspects of the wastewater treatment plant.

The KDHE standards for biosolids are identical to the EPA Part 503 regulations with the following addition relative to land application:

- Biosolids storage sites and drying beds must be lined or paved, and runoff and leachate controlled and treated.

4. Clean Water Act (CWA)

The federal CWA establishes requirements for all discharges to surface waters through the NPDES permit process. The authority for the Part 503 Sludge regulations is also provided by the CWA.

All point source dischargers are required to have an NPDES permit and to comply with the required effluent conditions. Biosolids management in compliance with the Part 503 regulations is required as part of the NPDES permit.

Industrial waste pretreatment requirements are also part of the CWA requirements. In establishing local limits for pretreatment, biosolids use must be considered.

5. RCRA Hazardous Waste Regulations, 40 CFR Part 261

RCRA regulations define and control the handling of hazardous waste. Wastewater biosolids are exempt from RCRA requirements unless it is determined to be a hazardous waste through testing of toxicity characteristics (Toxicity Characteristics Leaching Procedure).

6. Comprehensive Environmental Response Compensation and Liability Act

The CERCLA may be applied to require corrective actions to remove hazardous substances discharged to the environment. This legislation establishes liability and corrective actions for parties responsible for the discharge. The liability is extensive and comprehensive. While remote, the application of CERCLA liability to wastewater or biosolids could be possible if hazardous substances are traced to the biosolids.

7. City of Emporia and Lyon County Requirements

Local regulations which could impact wastewater treatment and biosolids operations include:

- Local Planning Commission – for technical and zoning review and approval
- County Health Department – for review of biosolids use or disposal practices and approval or disapproval of permits
- Watershed or Groundwater Management Districts – for review of biosolids use or disposal practices if within District boundaries

3.0 Population and Flow Projects

A. Population Growth

The City of Emporia Comprehensive Plan was adopted in March of 2008. It examined the population of Lyon County and the city from 1900 through 2000, and forecast growth through the year 2025. The previous nutrient study prepared by PEC utilized the population projections from the Comprehensive Plan. In 2010, the Federal Census was conducted and a population of 24,916 was established for Emporia. Using the annual growth rate of 0.4% and the baseline of the 2010 Census population for the City of Emporia, the 2050 Emporia population is estimated to be approximately 29,000 as shown in Table 4 and Figure 1.

Table 4: Population Projections

Year	City of Emporia
2010	24,916
2015	25,401
2020	25,886
2025	26,371
2030	26,856
2035	27,341
2040	27,826
2045	28,311
2050	28,796

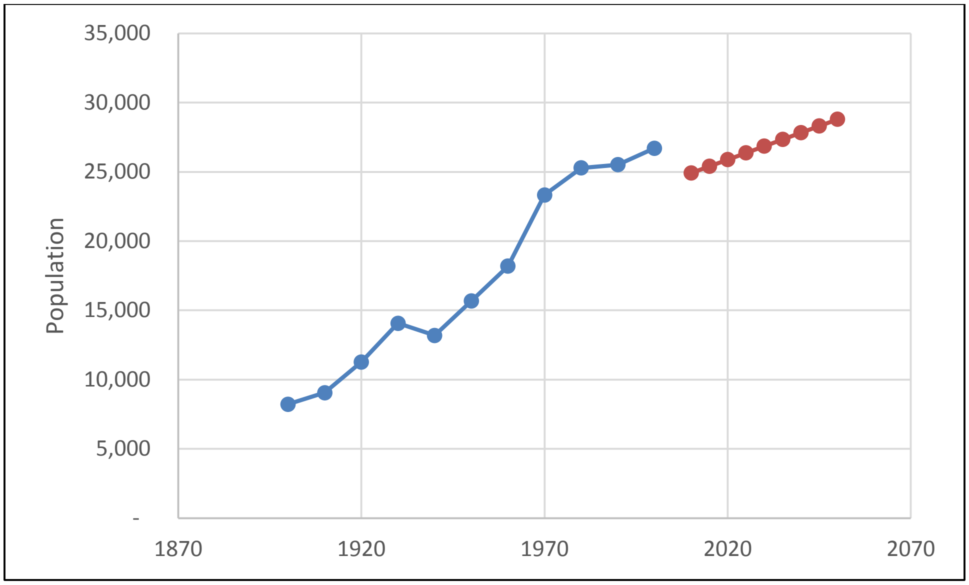


Figure 1: Population Grown and Projections for Emporia

B. Flow Projections

1. Average Flows

Projected wastewater flows are used to evaluate and size pumping stations, and headworks, biological treatment, sludge handling, and other facility processes.

The City provided average monthly flow data from January 2007 through September 2009 and from June 2013 through August 2014. The average daily influent flow rate for the WWTF for the current study period June 2013 through August 2014 was 1.94 MGD. The standard deviation of the flow data is a measure of the variation. Nearly 68% of all the flow data falls within one standard deviation of the average. To accommodate higher flows, the standard deviation of 0.43 MGD is added to the average of 1.94 MGD to give 2.38 MGD. The average daily influent rate has decreased some since 2009 as shown in Table 5.

Table 5: Average Daily Influent Flow

Period	Average Daily Flow (MGD)	Standard Deviation (MGD)	Average Total Flow
Jan 2007-Sep 2009	2.22	0.39	2.61
Jun 2013 – Aug 2014	1.94	0.43	2.38

To establish future flow projections, a flow per person per day is calculated, denoted as gallons/capita/day (gpcd), and multiplied by the population projections. In order to calculate a gpcd value, historic flow data is divided by the corresponding historic population data.

The current flow data of 2.38 MGD and 25,304 population results in a design value of 94 gpcd. Future average daily flow projections are calculated by multiplying 94 gpcd by the projected populations.

2. Peak Flows

Flow peaking typically occurs during storm events or periods of high use. Plant influent flow is pumped either to the treatment processes or to the extraneous flow basin.

The City provided daily plant flow data for 2007 and monthly data for 2008-2009 with maximum daily flows; this information is summarized in Table 6. The maximum peak factor was approximately twice the monthly average.

Table 6: Monthly Average and Daily Peak Flows for 2007 - 2009

	2007			2008			2009		
Month	Avg Month (MGD)	Peak Day (MGD)	Peak Factor	Average Month (MGD)	Peak Day (MGD)	Peak Factor	Average Month (MGD)	Peak Day (MGD)	Peak Factor
Jan	2.07	2.38	1.15	2.02	2.04	1.01	1.84	2.16	1.17
Feb	2.02	2.26	1.12	2.02	2.03	1.00	1.72	1.95	1.13
Mar	2.10	3.81	1.81	2.02	2.03	1.00	2.25	3.82	1.70
Apr	2.58	4.70	1.82	2.02	3.04	1.50	2.92	4.47	1.53
May	2.46	4.77	1.94	2.07	3.01	1.45	2.57	4.10	1.60
Jun	2.12	2.15	1.01	2.23	3.59	1.61	2.41	3.28	1.36
Jul	2.03	2.15	1.06	1.90	3.07	1.62	2.94	N/A	-
Aug	2.02	2.03	1.00	1.96	3.19	1.63	3.16	N/A	-
Sep	2.02	2.03	1.00	1.96	4.10	2.09	3.40	N/A	-
Oct	2.02	2.03	1.00	2.19	3.42	1.56			
Nov	2.02	2.03	1.00	2.04	2.57	1.26			
Dec	2.02	2.03	1.00	2.05	3.32	1.62			

The City provided daily plant flow data for June 2013 through August 2014 with maximum daily flows; this information is summarized in Table 7. The maximum peak factor was approximately twice the monthly average, consistent with the previous study findings.

Table 7: Monthly Average and Daily Peak Flows for 2013 - 2014

2013				2014			
Month	Average Month (MGD)	Peak Day (MGD)	Peak Factor	Month	Average Month (MGD)	Peak Day (MGD)	Peak Factor
Jun	1.48	1.74	1.18	Jan	1.60	1.74	1.09
Jul	1.70	3.24	1.91	Feb	1.72	1.82	1.06
Aug	2.76	4.35	1.58	Mar	1.65	1.85	1.12
Sep	1.64	1.83	1.12	Apr	1.70	2.20	1.29
Oct	1.89	3.15	1.67	May	2.13	2.37	1.11
Nov	1.88	2.21	1.18	Jun	2.88	5.03	1.75
Dec	1.60	1.83	1.14	Jul	2.14	2.38	1.11
				Aug	2.40	3.28	1.37

Table 8 shows future flow projections, assuming that the current industrial, commercial, and residential relationship with regard to wastewater production remains constant. The flow projections are based on the population projections established and a flow per person of 94 gpcd.

Table 8: Flow Projections

Year	Average Flow (MGD)	Peak Flow (MGD)
2010	2.34	4.68
2015	2.39	4.78
2020	2.43	4.87
2025	2.48	4.96
2030	2.52	5.05
2035	2.57	5.14
2040	2.62	5.23
2045	2.66	5.32
2050	2.71	5.41

C. Loading Projections

1. Organic Characteristics

Influent loading data provided by the City for the period 2007 - 2009 consisted of five-day biochemical oxygen demand (BOD) and total suspended solids (TSS). In 2007, the average concentration for BOD was 325 mg/L, while in 2008 the average BOD concentration dropped to 240 mg/L. This is likely due to the change in industrial contributors. Overall, the average influent BOD was 260 mg/L and TSS was 260 mg/L for the years 2007-2009. Updated influent loading data was provided by the City in August 2014 for the period June 2013 through August 2014. The average influent BOD for this period was 210 mg/L and TSS was 145 mg/L. The average influent values for BOD and TSS for 2007-2009 and 2013-2014 are shown in Table 9.

Table 9: Average Organic Influent Values

Parameter	2007	2008	2009	2013	2014
BOD (mg/L)	325	240	235	200	220
TSS (mg/L)	180	145	500	140	150

The KDHE has typical values for influent municipal wastewater BOD and TSS. In Table 10, these typical values are compared with the 2007-2009 and 2013-2014 average influent data to assist in verifying the projected BOD and TSS loadings.

Table 10: Per Capita Day Wastewater Loadings vs. Typical Values

City of Emporia 2007-2009		City of Emporia 2013-2014		KDHE Typical Values	
BOD (lb/capita/day)	TSS (lb/capita/day)	BOD (lb/capita/day)	TSS (lb/capita/day)	Typical BOD (lb/capita/day)	Typical TSS (lb/capita/day)
0.21	0.21	0.16	0.11	0.17	0.21

D. Nutrients and Criteria for Study

Nutrient loadings are also used to evaluate and size facility processes for accomplishing nitrification, de-nitrification, and phosphorus removal. Influent data revealed average values for these nutrients, and the criteria used for modeling is listed below in Table 11. A comparison is also included in Table 11 of the criteria used for modeling in the 2009 report and the criteria that will be used to update the modeling for the current report.

Table 11: Criteria for Study

Parameter	Design Value 2009	Design Value 2014
Daily Average Flow	4.6 MGD	4.6 MGD
BOD	260 mg/L	210 mg/L
TSS	260 mg/L	150 mg/L
Ammonia-Nitrogen	25 mg/L	32 mg/L
Total Kjeldahl Nitrogen	31 mg/L	42 mg/L
Total Phosphorus	7 mg/L	11 mg/L

E. Summary

The City of Emporia's average influent flow has decreased slightly since 2009 from 2.61 MGD to 2.38 MGD, but daily peak flow has maintained a peak factor of approximately 2. The design value for daily average flow will remain the same for the updated report. The organic and nutrient characteristics of the influent at Emporia WWTF have changed significantly in recent years. Average BOD and TSS concentrations have decreased while total nitrogen and total phosphorus influent concentrations have increased since the previous report. Total nitrogen concentrations are in the typical range for domestic wastewater with an average concentration of 42 mg/L. However, total phosphorus is significantly higher at 11 mg/L than the expected range for domestic wastewater which is 5 mg/L and the concentration used in the previous study of 7 mg/L. This change will have an impact on the models that have been created and may change the proposed construction options for meeting the new effluent limits set by KDHE. The future nutrient limits for the City of Emporia WWTF as advised by KDHE will be 10 mg/L for Total Nitrogen and 1 mg/L for Total Phosphorus.

4.0 Facility Evaluation

A. Facility Summary

The wastewater treatment plant is currently processing a daily average of approximately 1.94 million gallons per day (MGD) of wastewater. Treatment processes include influent screening, pumping and grit removal, followed by primary sedimentation, aeration basins, intermediate clarification, trickling filters, final clarification, ultraviolet disinfection, effluent pumping and cascade re-aeration.

Table 12 below was included in the original study from 2010 to summarize the full timeline of improvements made to the WWTP since its original construction. No major improvements have been constructed since 2010, so this table is included is this report as originally presented.

Table 12: Wastewater Treatment Plant Improvement Timeline

Year	Improvements
1920	Screen, Imhoff tank, sprinkling filter, secondary settling tank Sludge drying bed
1940	Operations building New primary settling basin New primary and secondary digesters (converted and covered Imhoff tank)
1948	Offsite pump stations
1957	New screen and grit chamber One existing primary settling basin New primary distribution well and second primary settling basin Replaced sprinkling filter with two trickling filters and one final settling basin Increased size of sludge drying beds
1963	Third primary settling basin Second final settling basin Second primary digester and sludge control building New sludge drying beds
1969	New pump stations Increased sludge drying beds

Year	Improvements
1976	Pump stations
1977	New operations building New presedimentation basin and holding pond New grit chamber New tower filters Two new intermediate settling basins New effluent pump station Scum and sludge pumping improvements
1980	Pump stations
1983	New belt filter press building Operations building addition
1990	Replaced tower filters with aeration basins and blow building New sludge thickener building
1999	New UV disinfection Final settling basin launder modification Effluent pumping modifications New cascade structure
2002	New fine screen New grinders before raw sludge pumps New primary digester New gas control building Improvements to solids dewatering and sludge heating

A schematic of current plant processes is included in Appendix 2. The physical condition of plant processes was examined visually in 2010. The following descriptions are included from the original study and have been updated based on recent conversations with City staff.

B. Influent Screening

1. Description

Screenings and grit removal is the physical removal of non-biodegradable items such as large, coarse rag-like materials, plastics, and smaller inorganic objects that cannot be reduced biologically in the remainder of the plant. Non-treatable materials that are not removed have a tendency to take up space in basins, clog pumps, and wear out equipment.

Therefore, their removal not only makes treatment more efficient, it also protects equipment from unnecessary damage.

The city's wastewater flows from the collection system into a 42-inch pipe leading to the screening channels. There are two climbing screens, with the newest being installed in 2002.

The non-biodegradable waste that is collected on the screens is collected in a dumpster to be hauled to the landfill for disposal.

2. Inventory

Influent Screens

Manufacturer:	Parkson
Model:	Aquagard with screw compactor
Motor:	¾ HP screen
	5 HP screw compactor
Electrical:	460V/ 3-phase
Installation:	2002

Manufacturer:	FMC
Model:	Linkbelt Thru-Clean
Motor:	1.5 HP
Electrical:	460V/3-phase
Installation:	1978

3. Capacity

The FMC Linkbelt has a width of 3 ft 4 in with one-inch openings; the Parkson Aquagard is three feet wide with 5/8-inch (15 mm) openings.

4. Condition

The FMC Linkbelt is over 30 years old and past its useful life. Budget has been established for its replacement. The Parkson Aquagard is relatively new and in good condition. There is a concern about future maintenance because of its one-piece construction. Removal would require creating access through the roof.

C. Influent Pumping

After screening, flows are either pumped to the grit removal system or to the pre-sedimentation and overflow basins. Two 14-inch ABB magmeters record the respective flows.

1. Inventory

Manufacturer:	Fairbanks Morse
Model:	5711
Type:	Vertical angle flow solids handling
Number:	Four
Motor:	Two pumps 75 HP, 860 rpm and adjustable speed magnetic drives (eddy current clutch)
	Two pumps 50 HP, 860 rpm and constant speed
Electrical:	460 V/3-phase
Installation:	1978

2. Capacity

The 75 HP pumps have a design point of 5600 gpm at 31 feet total design head (TDH); they provide flow to the rest of the treatment plant. The 50 HP pumps have a design point of 4500 gpm at 27.5 feet TDH and send flows to the overflow pond. There are valves which also permit the primary pumps to send flows to the pre-settling basin and overflow pond if necessary. The overflow pond has a capacity of approximately 3 MG and it discharges to the effluent pump station.

3. Condition

The influent pumps are over 30 years old and well beyond their intended useful life. The volutes are somewhat worn and the City previously received pricing to rebuild the pumps; however, the eddy current clutch drives are an older technology and it is not likely that these can be refurbished.

D. Grit Removal

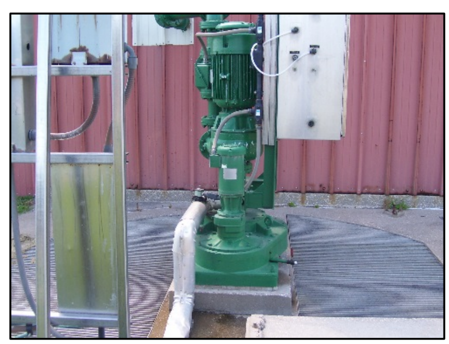
1. Description

The grit removal structure receives flow from the influent pumps and scum and solids from the final clarifiers. Grit is settled in the vortex separator. Treated effluent flows by gravity to the primary sedimentation basins. A valve at the bottom of the separator opens on a timed basis to transfer the settled grit to the grit classifier. The classifier augers the grit to a dumpster while the water transferred from the separator is returned to the head of the plant. The non-treatable waste that is collected in the dumpster is hauled to the landfill for disposal.

2. Inventory

Vortex Grit Unit

Manufacturer:	Smith and Loveless
Model:	Pista Model 12
Motor:	7.5 HP Pista Grit turbopump
Electrical:	460 V/3-phase
Installation:	2002



Grit Dewatering

Manufacturer:	Goodman
Model:	Model 10
Electrical:	460 V/3-phase
Installation:	2002

3. Capacity

The listed capacity for a Model 12 Pista vortex unit is 12 MGD. The Goodman grit dewatering unit has a capacity of 50 gpm.

4. Condition

The grit removal and dewatering equipment is relatively new and in good condition.

E. Primary Sedimentation

1. Description

Following grit removal, primary sedimentation allows other readily settleable solids to be removed from the effluent stream. A splitter structure is located ahead of the basins and slide gates are manually operated to direct flow to the three rectangular primary sedimentation basins, which are equipped with chain and flight solids collectors. Settled solids from the primary sedimentation basins are pumped to the primary digesters, and clarified effluent is pumped to the aeration basins for further treatment.

2. Inventory

Rectangular Clarifiers

Manufacturer:	Walker/Link Belt drives
Motor:	1.5 HP
Number:	Three
Electrical:	Three-phase
Installation:	1947 (easternmost), 1957 and 1962 (westernmost)

Primary Sludge Progressing Cavity Pumps

Manufacturer:	Moyno
Model:	ISWG1OH
Motor:	7.5 HP
Number:	Two
Electrical:	460 V/3 phase
Installation:	1979

3. Capacity

The oldest basin was built in 1947 with two trains of 14 ft by 60 ft with 10 ft water depth. In 1957 and 1962 additional basins were constructed with dimensions of 40 ft by 60 ft by 10.5 ft water depth. Detention time for all three basins at the design flow of 4.6 MGD is 2.5 hours, greater than the KDHE minimum of 2 hours. The maximum primary clarifier surface overflow rate per KDHE standards is 1000 gpm/sf. With a total available surface area of 6480 square feet, the surface overflow rate is 710 gpm/sf at the design flow.

The sludge pumps have a capacity of 80 gpm. They pump alternately to each of the primary digesters.

4. Condition

These basins are some of the oldest components in the plant and the splitter structure is showing considerable wear. The eastern and central basins were recently recoated and received new troughs and chain flights. Similar maintenance is scheduled for the western basin.

The sludge pumps appear to be overall beyond their intended useful life, but were rebuilt in 2014.

F. Pump Station

1. Description

Clarified effluent from the primary sedimentation basins travels to the pump station, where it is combined with return activated sludge and pumped to the aeration basins. Under most conditions, only one pump is running and lead status is rotated among the pumps.

2. Inventory

Process Pumps

Manufacturer:	Fairbanks Morse
Model:	19" Vertical Turbine
Number:	Three
Motors:	Two pumps 75 HP, 1170 rpm
	One pump 100 HP, 1170 rpm
	All on variable speed drives
Electrical:	460 V/3-phase
Installation:	1990

3. Capacity

The pumps each have a design point of 3500 gpm at 60 ft TDH.

4. Condition

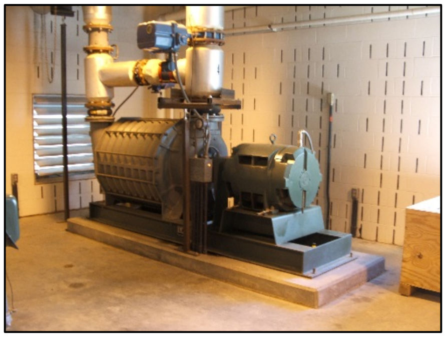
The 100 HP motor was added more recently than the initial installation, but the precise year is unknown. All pumps appear to be in good condition, although the piping into the wetwell was upgraded to stainless steel in 2002 due to corrosion.

G. Biological Treatment

1. Description

A splitter structure directs flow to either the east or west aeration basin. In this aerobic environment, oxygen is supplied via fine bubble diffusers to satisfy the energy needed by the microorganisms in the assimilation of the organics and nutrients in the incoming wastewater, and to allow oxidation of ammonia to nitrate-nitrogen.
The amount of time that microorganisms are kept in the biological process is termed the solids retention time (SRT). Once an optimum SRT is established, it should vary ever so slightly to maintain consistent treatment efficiency. Slight variations may occur in the

summer and winter months due to biological activity as it relates to temperature. A minimum SRT is required to achieve nitrification (the conversion of ammonia to nitrate).



2. Inventory

Centrifugal Blowers

Manufacturer:	Lamson
Number:	Four
Motor:	200 HP
Electrical:	460 V/3-phase
Installation:	1990

Fine Bubble Diffusers

Manufacturer:	Wyss
Array:	Full floor coverage, 2019 each basin
Installation:	1990; 2009

3. Capacity

The blowers can provide 8000 cubic feet per minute (cfm) each. There are two aeration basins, each 95 ft by 75 ft by 20 ft deep, containing approximately one million gallons.

4. Condition

The operation of the blowers was originally automated. Currently, staff take manual dissolved oxygen readings and adjust the blowers manually. The diffusers in the south basin were replaced in 2009 and those in the north basin were replaced in 2010.

H. Intermediate Clarification

1. Description

After the flow passes through the aeration basin splitter structure, it travels into two separate pipes, each leading to an intermediate clarifier. The intermediate clarifiers provide a quiescent period that allows the activated sludge to settle and leave a clear supernatant to discharge over the weirs. The supernatant leaving the clarifiers travels to the trickling filters. The settled solids are returned to the biological process, via control valves which direct this return activated sludge (RAS) to the settled sewage pump station, and back to the aerobic basins. As the microorganisms are constantly reproducing during their consumption of the influent organic matter and nutrients, a portion of the biomass must be regularly removed, or wasted, from the system to maintain the proper balance of food (organics in the wastewater) and microorganisms. The portion removed is referred to as Waste Activated Sludge (WAS). The WAS is pumped to the aerobic digesters, which is discussed in more detail later.

Surface overflow rates, or liquid rise rates, should be maintained below 425 gallons per day per square foot (gpd/sf), and are normally calculated based on the water surface at the weirs. There is a smaller diameter section created by the extension of the inboard launder floor into the basin. The liquid rise rate is increased at that reduced diameter section, potentially impeding the creation of the quiescent settling conditions required in the upper portions of the clarifier. To maintain a maximum rise rate of 400 gpd/sf at any point in the clarifier, the cross-section area at the reduced diameter “throat” section must be used.

The ideal detention time in a clarifier is dependent on the characteristics of the biomass arriving from the aeration basin. A short detention time may not provide an adequate period of quiescent conditions for a slow-settling biomass. However, a detention time that is too long could result in de-nitrification occurring in the clarifier which causes bubbles of nitrogen gas to rise to the surface potentially carrying solids to the surface as well. Maintaining a proper flow of biomass to a clarifier is dependent on the solids loading rate.

Solids loading rate is defined as the rate at which biomass is being applied to the clarifier for settling. Calculation of the solids loading rate requires the concentration of biomass leaving the aeration basin, the plant flow rate, and the RAS flow rate to be taken into account. The resulting load (in pounds per day) of biomass is divided by the clarifier bottom area available for settling. The solids loading rate should be maintained below 20 pounds per day per square foot (lbs/day/sf).

2. Inventory

Circular Intermediate Clarifiers

Manufacturer:	Walker Process
Number:	Two
Diameter:	70 ft external, 62.5 ft at water surface
Motor:	1.0 HP drives
Electrical:	460 V/3-phase
Installation:	1977, 1990 updates

3. Capacity

The full diameter of each clarifier is 70 ft, but with the inboard covered weirs the diameter becomes 62.5 ft for a total surface area at the throat of 6136 ft2. For the recommended maximum surface overflow rate of 400 gpd/ft2, the flow capacity with both units operating is 2.4 MGD.

4. Condition

In 1990 the intermediate clarifiers were updated with stilling rings, internal baffling and weir covers. Current visual inspection reveals inadequate settling.

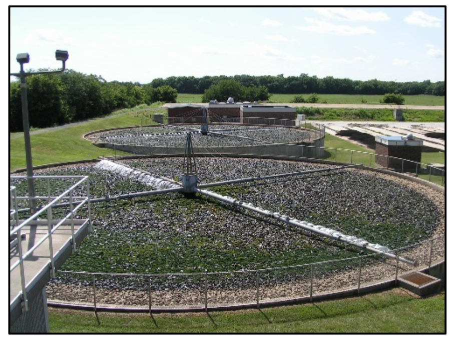
I. Trickling Filters and Final Clarification

1. Description

In 1957, two trickling filters were constructed at the plant, replacing the original sprinkling filters as the primary biological treatment. With the addition of aeration basins, the trickling filters remained as a secondary treatment stage, to further reduce BOD.

Effluent is distributed continuously over the top of the trickling filter through rotating distribution arms. Microorganisms grow as a biofilm on the trickling filter media and decompose the organic material in the wastewater. The effluent is collected at the bottom of the filter and travels via gravity to the final clarifiers where solids are separated from the treated wastewater.

2. Inventory



Trickling Filters

Manufacturer:	N/A
Number:	Two
Diameter:	120 ft
Installation:	1957

Circular Final Clarifiers

Manufacturer:	Walker Process
Number:	Two
Diameter:	75 ft
Motor:	1.0 HP
Electrical:	460 V/3-phase
Installation:	1957, 1963

Scum and Solids Wasting Pumps

Manufacturer:	Fairbanks Morse
Model:	5400
Number:	Four, two per clarifier
Motor:	3 HP
Electrical:	460 V/3-phase
Installation:	1979

3. Capacity

The trickling filters receive clarified effluent that is high in nitrates, but low in BOD. While there is some reduction in BOD, there is no denitrification taking place.

As discussed with the intermediate clarifiers, the surface area at the throat of the clarifier must be used when considering surface overflow rates. The inboard covered launders extend 4.5 feet from the wall, creating an inside diameter of 66 feet. With a surface overflow rate of 400 gpd/sf and total available surface area of 6842 square feet, the capacity of both clarifiers together is 2.7 MGD. Also, the side water depth is approximately 6 feet, which is less than the 10 feet recommended as a minimum by KDHE.

The scum and solids wasting pumps have a design point of 320 gpm at 15 ft TDH.

4. Condition

Despite being some of the older components of the plant, the filter and settling basin concrete appears in good condition. The trickling filters are covered with a mossy growth at the surface, and there is a significant layer of earthworms approximately two feet below.

J. UV Disinfection

1. Description

The disinfection of plant effluent is achieved with ultraviolet (UV) irradiation. UV disinfection transfers electromagnetic energy from a mercury arc lamp to an organisms' genetic material. When the UV radiation penetrates the cell wall of an organism, it destroys the cell's ability to reproduce.

2. Inventory

Open Channel UV

Manufacturer:	Ultratech
Type:	Low pressure, low intensity mercury vapor lamps 65% transmittance
Number:	2 channels; 5 modules/channel 40 lamps/module
Installation:	1999

3. Capacity

The design capacity for this installation is listed at 1 MGD per module or 10 MGD total. Currently both channels are used, but it is possible to divert flow around the UV building and to the effluent pump station.

4. Condition

There is an automated scouring system and once a month the lamps are pulled and cleaned manually. The system is felt to be in good condition and performs well for current flows. The system originally included a flow proportional control system to automatically adjust lamp intensity based on flow. This system is not currently functional and staff manually adjust the system. The automatic flow proportional system should be repaired or replaced to allow for more efficient operation.

K. Effluent Pumping

1. Description

Disinfected effluent passes through the effluent pump station before it outfalls to the Cottonwood River. Under low stream flow conditions, the effluent can flow by gravity to the outfall. Effluent pumping is used when the level of the Cottonwood River is high.

2. Inventory

Effluent Turbine Pumps

Manufacturer:	Fairbanks Morse
Model:	8211A
Number:	Four
Motor:	40 HP, 1800 rpm
Electrical:	460 V/3-phase
Installation:	1977

3. Capacity

The four pumps each have a design point of 3650 gpm at 25 ft TDH. They are called to run based upon a weir level indication, but there is a great deal of wear at the weir and some question about accuracy. When a pump is noted to be running, the operator must go and shut a gate to prevent flows from backing up in the rest of the plant.

4. Condition

These pumps were initially installed in 1977 and are beyond their expected useful life.

L. Solids Handling Processes

1. RAS Control and WAS Pumping

a. Description

The settled sludge is transported to the RAS control structure from the bottom of each intermediate clarifier by gravity. Telescoping valves regulate the amount of return sludge which continues via gravity to the settled sewage pump station and then is pumped, along with the primary clarifier effluent, to the aeration basins. The RAS is vital to the process in that it provides the untreated wastewater with microorganisms that metabolize organics and nutrients, and biologically flocculates particulates resulting in better biomass settleability.

A portion of the biomass must be regularly removed, or wasted, from the system to maintain the proper balance of food (organics or BOD) and microorganisms. The portion removed is referred to as Waste Activated Sludge (WAS). The WAS pumps located in the RAS control structure remove a portion of the RAS stream and pump it to the gravity sludge thickener.

b. Inventory

Centrifugal pumps (WAS to gravity thickener)

Manufacturer:	Fairbanks Morse
Model:	5400
Number:	Two
Motor:	3 HP, 1200 rpm
Electrical:	460 V/3-phase
Installation:	1977

c. Capacity

Each pump has a design capacity of 320 gpm at 14 ft TDH.

d. Condition

These pumps were initially installed in 1977 and are beyond their expected useful life.

2. Sludge Thickening

a. Description

Here the solids are further concentrated before being pumped to the anaerobic digesters.

b. Inventory

Circular gravity thickener

Manufacturer:	Walker
Diameter:	40 ft
Sidewater depth:	12.4 ft
Installation:	1990

Progressive cavity pumps

Manufacturer:	Netzsch
Model:	NE90A
Number:	Two
Motor:	10 HP, 1200 rpm
Electrical:	460 V/ 3 phase
Installation:	1990

c. Capacity and Condition

The progressive cavity pumps have a capacity of 180 gpm. This process was added to the plant in 1990 and components are in good condition.

3. Anaerobic Digestion

a. Description

Sludge stabilization is achieved with anaerobic digestion. Solids are removed from the primary settling basins on a timed basis and pumped to one of the primary digesters by the raw sludge pumps. The digesters also receive thickened sludge from the gravity thickener.

Sludge passes through two digesters in series, with the primary digester being heated and mixed and the secondary digester providing storage. This process reduces the concentration of organic materials and pathogens in the waste sludge. The maximum solids produced are 3-4%. The methane produced in the digestion process is currently burned off.

b. Inventory

Digesters

Type:	Anaerobic, fixed cover, 50 ft diameter
Number:	Three (2 primary, 1 secondary)
Mixing:	Gas mixing system
Heating:	Burnham Industrial and Weil McLain boilers; Shell and tube heat exchangers
Installation:	1940, 1963, 2002

Sludge Recirculation Pumps

- New Primary Digester

Manufacturer:	Hayward Gordon
Number:	Two
Motor:	7.5 HP, 1200-1800 rpm (two-speed)
Electrical:	460 v/3 phase
Installation:	2003

- First Primary Digester

Manufacturer:	Wemco, Fairbanks Morse
Number:	Three
Motor:	3 HP, 1200 rpm
Electrical:	460 v/3 phase
Installation:	1963, 1977

c. Capacity

The maximum liquid level in the primaries is 21’3” for a capacity of approximately 312,000 gallons. The secondary has a maximum liquid level of 22’0” for 323,000 gallons of storage. The newer sludge recirculation pumps have a design capacity of 300 gpm at 40 ft TDH.

d. Condition

The digester constructed in 1940 is now the secondary digester, and extensive improvements, including cover replacement, were undertaken in 2002. However, the older sludge recirculation pumps require frequent maintenance, and because the dryers do not perform efficiently, the boilers are running on natural gas rather than the digester gas.

4. Sludge Dewatering

a. Description

After digestion, the solids are pumped to the belt filter press and further dewatered. The sludge cake is then loaded onto a truck and stored in the outside bays. Private haulers have contracts with the City to transfer the sludge to area farms.

b. Inventory

Belt Filter Press Feed Pump

Manufacturer:	Netzsch
Model:	NE90A
Number:	One
Motor:	10HP, 150 gpm
Electrical:	460 v/3 phase
Installation:	2002

Belt Filter Press

Manufacturer:	Ashbrook
Model:	Winklepress
Number:	One
Electrical:	460 V/3 phase
Installation:	2002

c. Capacity

The two-meter belt filter press has sufficient capacity for current and future solids production.

d. Condition

All components are less than fifteen years old and in good condition.

M. Plant Support Systems

1. Emergency Power

There are two main power lines entering the facility from one substation, but each service comes from a different transformer which generally ensures that emergency power is available. The WWTP has experienced power fluctuations and a few outages recently. Evaluation of the power supply system is recommended to determine the need for generator emergency power at the WWTP.

2. SCADA

The plant is currently controlled manually and staff has been very successful with this mode of operation. In the future, however, as treatment limits become more stringent and new processes are added, the facility would benefit from implementation of a new SCADA system. The current SCADA system only monitors influent and effluent flow rates, and can operate the raw sludge and sludge recirculation pumps.

The current manual (conventional) operation of the WWTP is a proven and reliable method of operation that has served the City of Emporia well. Conventional monitoring also has the following advantages over computer-based systems:

- Lower initial capital costs.
- Less operator training required in its use.
- More operator familiarity with the technology used which translates to easier troubleshooting.

Disadvantages of conventional operations include:

- More staffing is usually required. Also, more 24/7 operations are required with no remote monitoring or operation capabilities.
- Less information tends to be written down and information leaves with turnover.
- Paper operations and maintenance systems require a great deal more effort on the part of the personnel running the plant than do computerized maintenance management systems (CMMS). Therefore, O&M tends to be more reactive and less predictive or proactive.

On the other hand, most facilities benefit from computer-automated SCADA (Supervisory Control and Data Acquisition) systems. SCADA provides an owner many more options in operations:

- Distributed instead of centralized control systems.
- Remote monitoring and control.
- Fewer personnel are generally required to operate the plant (elimination of nighttime shifts) or staff is freed to take a larger role in predictive and/or proactive maintenance.
- Higher reliability due to solid-state components in sealed enclosures.
- Greater flexibility by customizing software.
- Greater expansion capabilities (new treatment trains, remote lift stations, etc.).
- Ease of report generation.
- Enhanced operation, decision making with multiple real-time inputs, and understanding of/reaction to trends instead of responding to alarms.

Disadvantages of SCADA operational systems include:

- Higher capital costs.
- More operator training required.
- Must have backup conventional controls in case of a computer malfunction.

SCADA systems can allow for manual, automated, and/or remote plant control/monitoring and assist the staff by performing the following computer-related tasks: data acquisition and logging, report generation, alarm indication, plant graphic displays, and analog variable displays. Typically, a SCADA system will consist of multiple PCs running a Windows-based software package such as Wonderware. Standard software graphics should be customizable for any WWTP and display realtime data, trending, reports, alarms, etc. and be compatible with standard word processing and spreadsheet software packages. The PCs would be tied together with an Ethernet backbone. Off-site facilities (such as lift stations) could communicate to the WWTP network via telephone or radio.

As previously discussed, well-designed SCADA systems can greatly improve the efficiency of a WWTP. These efficiencies often translate to reduced or redirected staff levels, single-shift operations, more effective maintenance management, and enhanced operations.

Table 13 indicates the status of major equipment. There are a number of components which are well beyond their useful lives, and will require replacement regardless of process changes for nutrient removal. These items should be included as Capital Improvement Projects for the City of Emporia.

Table 13: Status of Major Equipment

Item	Installation Year	Status/Action Required
Influent FMC Linkbelt screen	1978	Replace
Influent Parkson Aquagard screen	2002	Good condition
Grit removal equipment	2002	Good condition
Influent Fairbanks Morse pumps	1978	Replace
Primary sedimentation basin	1962	Replace all drives and bearings
Primary sludge Moyno pumps	1979	Replace
Fairbanks Morse turbine pumps	1990; 2002	Replace for Alternative scenarios
Lamson blowers	1990	Good condition
Wyss fine bubble diffusers	1990; 2009	Good condition
Intermediate clarifiers	1977; 1990	Additional clarifiers needed for design flow
Trickling filters	1957	Remove for Alternative scenarios
Final clarifiers	1957; 1963	Remove for Alternative scenarios
Scum Fairbanks Morse pumps	1979	Remove for Alternative scenarios
UV disinfection	1999	Good condition
Effluent Fairbanks Morse pumps	1977	Replace
Fairbanks Morse WAS pumps	1977	Replace
Gravity thickener	1990	Replace for Alternative scenarios
Netzsch sludge pumps	1990	Replace for Alternative scenarios
Sludge digestion gas mixing system	2002	Replace dryers
Hayward Gordon sludge recirc pumps	2003	Good condition
Fairbanks Morse/Wemco sludge recirculation pumps	1977	Replace
Netzsch belt filter press feed pump	2002	Good condition
Ashbrook Winklepress	2002	Good condition

5.0 Alternatives

A. Summary

In its current configuration, the treatment plant is not accomplishing denitrification and is not able to achieve the nutrient removal effluent limitations proposed by the KDHE. The goals included in the current NPDES permit are an effluent nitrogen level of 10.0 mg/L and an effluent phosphorus level of 1.0 mg/L.

Wastewater treatment alternatives for nutrient removal are selected, first to remove the contaminants from the water through physical/biological means, and if that is not possible then through chemical/physical means. The characteristics that are examined to determine the treatment processes to be used are BOD, Total Nitrogen, and Total Phosphorus. When the relationship of BOD:Nitrogen:Phosphorus is greater than 20:5:1 then Biological Processes would be favored; if the relationship is less or discharge limits are very low then chemical/physical processes would be favored.

B. Water Quality Criteria

The nutrients of concern are total nitrogen and total phosphorus.

- Total nitrogen in wastewater is mostly comprised of ammonia and organic nitrogen. Some organic nitrogen is not biodegradable in a wastewater treatment plant and some is bound into the cell mass or flocculated into the settable solids and is removed with the biosolids.
- Ammonia nitrogen is oxidized to nitrite then to nitrate but is not removed from solution unless denitrification takes place.
- Total phosphorus is in solution and a small portion is assimilated into the cell mass of the biological process if the growth environment is manipulated the cell mass can be tricked into assimilating additional phosphorus. If luxury uptake by the cell mass is not adequate then coagulation chemicals are used to precipitate phosphorus from solution.

Treatment alternatives are based upon the method used to stabilize the residual solids anaerobically or aerobically. Anaerobic digestion requires high strength solids which results in a low BOD:Nitrogen:Phosphorus Ratio and requires a chemical physical process. Aerobic digestion can work well with low strength residuals resulting in a BOD:Nitrogen:Phosphorus Ratio that would allow biological/physical treatment processes.

C. Modeling

The purpose of the current study is to evaluate the previously recommended improvement scenarios based on the WWTP's current influent characteristics and new effluent limits, and determine what modifications would be necessary to meet the limits of 10.0 mg/L Total Nitrogen and 1.0 mg/L Total Phosphorous.

The current influent characteristics based on recent data provided by the City are different from the previous study. The parameters used in the previous study are compared to current influent parameters in Table 14.

Table 14: Influent Parameters for 2014 Study Update

Parameter	Design Value (2010)	Design Value (2014)
Daily Average Flow	4.6 MGD	4.6 MGD
BOD	260 mg/L	210 mg/L
TSS	260 mg/L	150 mg/L
Ammonia-Nitrogen	25 mg/L	32 mg/L
Total Kjeldahl Nitrogen	31 mg/L	42 mg/L
Total Phosphorus	7 mg/L	11 mg/L

Since the new KDHE requirements are only based on one level of nutrient removal, the models created in the previous study for the BNR scenarios were revised to reflect current influent characteristics and evaluated to determine what modifications to the original recommendations would be required to meet the proposed effluent limits of 10.0 mg/L Total Nitrogen and 1.0 mg/L Total Phosphorous.

The three original base alternatives were evaluated by revising the original models to determine if additional treatment volume alone or chemical addition alone would be sufficient to meet the effluent limits, or of both additional volume and chemicals were necessary. Based on this modeling analysis, original Alternative No. 2 and No. 3 appear to be the most feasible options with the current influent characteristics and new effluent limits.

D. Alternative No. 2

This alternative is based upon converting the anaerobic digestion process to aerobic treatment and modifying the existing treatment facility. The primary and secondary treatment systems (primary/intermediate/final clarifiers and trickling filters) would be removed. New construction would consist of anoxic basins and membranes to work in concert with the existing aeration basins. This process would be monitored by instrumentation and controlled through the plant SCADA system to optimize process operations.

The process elements identified in the previous study for Alternative No. 2 to meet BNR limits remain the same, but additional anoxic zone volume and chemical addition were required to achieve the new effluent limits. The process elements are identified in Figure 2, found in Appendix C.

1. Preliminary Treatment

Preliminary treatment would continue to utilize the existing screening and grit removal units to separate the larger non-treatable materials from the waste stream.

2. Primary Treatment

The primary clarifiers would be removed from the process.

3. Secondary Treatment and Nutrient Removal

The trickling filters and the intermediate and final clarifiers would be removed from the process and replaced with anaerobic and anoxic basins before the existing aerobic basins, membranes and chemical addition.

4. Phosphorus Removal

To achieve the effluent limit of 1.0 mg/L Total Phosphorus a metal salt such as ferric chloride would be added prior to the anoxic basins. The subsequent precipitate would be removed from the flow by the membranes.

5. Nitrification

The aerobic basin BOD is assimilated into micro-organism cell mass, the ammonia nitrogen is converted to nitrate, and phosphorus is consumed.

6. Denitrification

For this alternative, denitrification would be achieved with anoxic basins placed before the existing aerobic basins where nitrogen will be released to the atmosphere. A portion of the flow from the aerobic basins would be returned to the anoxic basins, providing a source of carbon for the micro-organisms.

7. Membrane Filtration

Membranes would be installed to remove the last of the particulates in the water. These particulates contain small concentrations of nitrogen and phosphorus that are measured in the effluent concentration as it is discharged. The membranes must be periodically backwashed, and the resulting flow is sent back through the treatment process. This polishing step replaces and surpasses the capabilities of conventional clarification.

8. Disinfection, Re-aeration and Outfall

The final step in the wastewater treatment process is disinfection and re-aeration. The current permit includes weekly and monthly average requirements for the number of colony forming units per 100 milliliters of E coli in the effluent from the treatment plant. This effort is provided by the ultra-violet light disinfection process. The only modifications would be in instrumentation and SCADA system for overall plant control.

9. Residual Solids Handling

a. Sludge Thickening

A rotary drum thickener is recommended for thickening the sludge to approximately 5% solids. The existing gravity thickener was designed for lower loading conditions, and a rotary drum thickener can accomplish thickening of the increased solids production more efficiently and with a smaller footprint.

b. Aerobic Digestion

The change to aerobic digestion has a major impact on the wastewater treatment plant but has several benefits. Aerobic digesters work best without the raw sludge from primary clarifiers and, consequently, will meet Class B biosolids with WAS as the only feed source. Another advantage of aerobic digestion is that it minimizes the release of nutrients back to the process, which simplifies the liquid portions of the treatment process.

Based upon calculations of projected loading under worst case conditions, the existing primary and secondary digesters do not have enough volume to be converted to aerobic digesters to meet design year requirements. An additional 950,000 gallons (3 more digesters) would need to be constructed. In addition to construction of new digesters, modification of the existing basins to aerobic digesters would require the following:

- Remove the digester covers and equipment from the basins
- Remove the heat exchangers, boilers and support equipment
- Install an aeration system and mechanical mixers in each basin
- Install blowers to support the aeration system
- Reconfigure the piping to support the new process
- Provide instruments to monitor dissolved oxygen and monitor the various flows
- The aerobic digester would receive thickened waste activated sludge from the new thickening process
- Digested sludge would be pumped to the existing dewatering system for disposal

c. Dewatering, Storage and Disposal

Dewatering of residual solids via the belt filter press removes the excess liquid from the material, changing it from a thin liquid to a cake solid with up to 20% solids. The consistency of this material is similar to damp earth, is readily stackable, transportable, and can be stored on site for up to a year prior to disposal. It is important that once dewatered, the material should not be rewetted. Rewetted biosolids become difficult to transport and can be an odor problem. The existing storage beds are un-covered and a protective roof may be considered.

E. Alternative No. 3

As with Alternative No. 2, this alternative is based upon converting the anaerobic digestion process to aerobic treatment and modifying the existing treatment facility. The primary and secondary treatment systems (primary clarifiers, trickling filters, and current intermediate clarifiers) would be removed. New construction would consist of anaerobic basins, anoxic basins, and additional clarifier volume. New instrumentation and controls would optimize process operations.

The process elements identified in the previous study for Alternative No. 3 to meet BNR limits remain the same, but chemical addition is required to achieve the new effluent limits with the 2014 influent parameters. The process elements are identified in Figure 3, found in Appendix C.

1. Preliminary Treatment

The existing screening and grit removal units would continue to be used to separate the larger non-treatable materials from the waste stream.

2. Primary Treatment

The primary clarifiers would be removed from the process.

3. Secondary Treatment and Nutrient Removal

In general, BOD removal, ammonia conversion, denitrification and luxury phosphorus uptake occur biologically in a series of basins. The trickling filters and current intermediate clarifiers would be removed from the process. Construction would consist of anaerobic and anoxic basins, and additional clarifiers.

4. Phosphorus Removal

Basins would be constructed to provide an anaerobic environment where micro-organisms release phosphorus back to the wastewater. In the aerobic basin, the phosphorus-starved micro-organisms-assimilate this phosphorus plus an additional luxury amount. To achieve the effluent limit of 1.0 mg/L Total Phosphorus, a metal salt such as ferric chloride would be added prior to the clarifiers to precipitate additional phosphorus.

5. Denitrification

An anoxic basin would be constructed to achieve denitrification. The flow entering this basin comes from the anaerobic process containing raw wastewater and the micro-organisms returned from the final clarifiers. This flow is mixed with a recycle flow from the aeration basin that contains a limited amount of oxygen, a significant concentration of nitrate, and additional micro-organisms. Within this anoxic basin, the micro-organisms continue synthesis using the oxygen molecules from the nitrate molecule, thereby releasing nitrogen gas to the atmosphere. This release of nitrogen gas reduces total nitrogen. Recycled flows allow multiple passes through the anoxic zone which maintain the micro-organism balance for the process. The higher the nitrate concentration in the recycle flows, the better the performance.

6. Nitrification

In the aeration basins, ammonia is converted to nitrate. This process includes several advantages.

- The initial anaerobic and anoxic basins consume BOD that does not have to be oxidized in aeration basin.
- Cycling aeration, anoxic and anaerobic conditions impairs the development of filamentous micro-organisms.
- Alkalinity is released back to wastewater during denitrification which allows the subsequent nitrification process to be more efficient.

Clarification following the aerobic basins allows the micro-organisms to settle out and either be returned to the denitrification process or wasted to the sludge thickening process.

7. Filters

Filters would be constructed to removes the last of the particulates in the water, and to reach the effluent nutrient limits. As previously described, these particulates contain small concentrations of nitrogen and phosphorus that would be measured in the effluent if not removed by filtration. To keep the filters fully functional they are to be backwashed on a periodic basis. The backwash contains the filtered solids and is returned for reprocessing and eventual removal in the clarifiers. Filtration rates, backwash cycles, discharge water quality and process control are per-formed through the plant SCADA system.

8. Disinfection, Re-aeration and Outfall

The final step in the wastewater treatment process is disinfection and re-aeration. The current permit includes weekly and monthly average requirements for the number of colony forming units per 100 milliliters of E coli in the effluent from the treatment plant. This effort is provided by the ultra-violet light disinfection process. The only modifications would be in instrumentation and SCADA system for overall plant control.

9. Residual Solids Handling

a. Sludge Thickening

Same process as Alternative No. 2.

b. Aerobic Digestion

Same process as Alternative No. 2.

c. Dewatering, Storage and Disposal

Same process as Alternative No. 2.

F. Cost Analysis

1. Capital Costs

Capital costs have been developed for the treatment alternatives based upon current construction costs. Inflation should be added to account for future costs to the year of construction. The opinion of cost has been developed to establish a budget and to provide a comparison between the alternatives to find the most favorable solution for the City of Emporia. The opinion of cost includes contractor fixed costs, project contingencies and non-contractor project costs which consist of the following:

- Contractor's fixed cost (12%): The contractor's fixed cost covers the contractor's job trailer, mobilization, supervision, bonding, insurance, management over site, etc.
- Construction contingencies (25%): The construction contingencies are unaccounted money budgeted as an allowance for unforeseen activities that occur during the project, covering unknown conditions, fluctuations in the economy and, design changes as a project develops.
- Project costs (20%): The project costs cover engineering fees, administration fees, inspection, bonding and legal fees.

Detailed capital costs are included in Appendix A.

Table 15: Opinion of Preliminary Costs for Treatment Alternatives

Item	Alternative No. 2	Alternative No. 3
Construction	$18,362,000	$12,600,000
Contingency	$4,591,000	$3,150,000
Project Costs	$3,673,000	$2,520,000
Total	$26,626,000	$18,270,000

2. Operations and Maintenance Costs

To be able to make informed decisions, total costs associated with each alternative must be understood. Because each alternative is different there is a change in the amount of energy utilized, and variation based upon the amount of equipment to be serviced. With improved automation and monitoring, it is anticipated that the same number of staff would be able to operate the facility at design conditions. Operations and maintenance cost estimates are presented in the following table and detailed costs are provided in Appendix B.

Table 16: Opinion of Preliminary Operation & Maintenance Costs for Treatment Alternatives

Alternative	Annual Cost
2	$1,796,000
3	$1,522,000

6.0 Beneficial Reuse of Treated Effluent

A. Purpose

The City of Emporia wastewater treatment plant (WWTP) currently discharges all of its effluent to the Cottonwood River, but is interested in the option to reuse the treated effluent. The practice of beneficial reuse of treated effluent decreases the volume of water and concentration of constituents that are discharged to the river and reduces the dependence on potable water. Treated effluent can be used for irrigation of agricultural land, irrigation of public grounds such as golf courses and ball fields, as process or cooling water for industries, or other uses where allowable by current regulations. The feasibility of beneficial reuse depends on the quality of water needed by the end user, the amount of water available in comparison to what the end user needs, and infrastructure and ongoing operations costs for any needed improvements to deliver the water to the end user.

This study evaluated the following potential end users for beneficial reuse of treated effluent based on proximity to the WWTP. The agricultural lands included are shown in Figure 4, and the remainder of the potential end users discussed are shown in Figure 5, both figures are found in Appendix E.

- Agricultural lands
- Emporia Golf Course
- David Traylor Zoo
- Soden's Grove Park
- Menu Foods

B. Potential Beneficial Reuse Options

1. Agricultural Lands

County records were reviewed to determine what agricultural properties were in the area of the WWTP. Only properties on the north side of the river were identified due to the cost of crossing the river with the needed pipelines. With this criteria, five properties were identified as shown in Figure 4, and summarized in Table 17.

Table 17: Adjacent Agricultural Properties

Property Number	Total Acreage	Distance from WWTP (mi)
1	75.7	Adjacent
2	20.7	Adjacent
3	206.1	0.3
4	35.3	0.13
5	16.5	0.4

A pump station and piping to an irrigation system would be required to serve the identified agricultural properties. The WWTP currently produces an average of approximately 1.94 MGD. This volume should be sufficient to serve one of the larger properties, or several of the smaller agricultural properties identified, depending on irrigation needs and total acreage that would be irrigated on each property.

2. Emporia Golf Course

The Emporia Golf Course is located approximately 5 miles south and west of the WWTP. In past years, the golf course used approximately 14 MG annually. However, a retention pond has been installed to capture and store storm water which is then used for irrigation of the golf course. This new water source has reduced the golf course's potable water use for irrigation to approximately 2 MG in 2014. Since water usage has been greatly reduced and is anticipated to continue to decrease, and due to the need to cross the Cottonwood River and approximately 5 miles of piping that would be required, the golf course will not be further considered as a feasible option for beneficial reuse.

3. David Traylor Zoo

The David Traylor Zoo is located approximately 0.4 miles west of the WWTP. Historically, the zoo has been a very large water user, with approximately 23 MG used per year. This total water usage primarily includes potable water for restrooms, drinking fountains, and concession stands; drinking water and habitat water for animals; wash down operations; and irrigation.

The Association of Zoos and Aquariums (AZA) is the accrediting agency for the David Traylor Zoo. The AZA published a guide in 2011 that included suggestions for zoos to conserve natural resources and become more sustainable entities. The recommendations listed for water usage included using recycle waste water for irrigation purposes, recirculating filtered and cleaned water from one exhibit to another, and general reuse of treated wastewater. There are currently no specific regulations regarding use of treated wastewater effluent in zoos, but the U.S. Department of Agriculture issued the Animal Welfare Act (AWA) in 1966 that provides guidelines for animal care in zoos including water requirements. This Act indicates that recycled wastewater cannot be used for animal drinking water, but can be used for cleaning of animal enclosures, and potentially for marine mammal habitats depending on the specific animal.

Based on historical usage, proximity to the WWTP, and the ability of treated wastewater effluent to be used at zoos for irrigation, wash down, and some marine habitats per current regulations, the David Traylor Zoo is a viable option for beneficial reuse. Pumps and piping would be required to provide beneficial reuse water to the zoo.

4. Soden's Grove Park

The Soden's Grove Park is located approximately 0.5 miles west of the WWTP and includes park facilities and a ball field. The park historically has used an average of approximately 0.7 MG of potable water annually over the last few years. These public areas can be irrigated with beneficial reuse water with the following restrictions: no watering when people are present and protection of drinking fountains from irrigation spray. Pumps and piping would be required to provide water to the park and ball fields.

5. Menu Foods

The Menu Foods facility produces wet pet foods for Simmons Pet food, Inc. and is located approximately 1.3 miles north and east from the WWTP. Historically the facility has used approximately 460 MG of water per year. Given this substantial usage, there may be reasonable possibilities for beneficial reuse of treated wastewater at this location. Discussions with plant personnel to understand their process and quality requirements for process water are the next step to fully evaluate this option.

C. Cost Analysis

Each potential option for reuse of the treated effluent from the WWTP would require storage and pumping at the WWTP, piping to the end users, acquisition of easements, and engineering design of the improvements. The estimated costs for these items are summarized below in Table 18. Additional costs may include storage facilities at the end user, additional piping within end user facilities, or additional pumping at the end user. Additional costs specific to each user would need to be evaluated on an individual basis should the City choose to further pursue supplying beneficial reuse water to that entity.

Table 18: Opinion of Preliminary Cost for Beneficial Reuse Options

Potential Beneficial Reuse Option	Estimated Cost
Agricultural Property No. 1	$905,000
Agricultural Property No. 2	$1,143,000
Agricultural Property No. 3	$1,754,000
Agricultural Property No. 4	$1,141,000
Agricultural Property No. 5	$1,560,000
David Traylor Zoo	$1,221,000
Soden's Grove Park	$1,253,000
Menu Foods	$1,726,000

7.0 Final Recommendations

The primary objectives of this planning level document were to develop a preliminary course of action for KDHE and the City of Emporia to achieve the proposed nutrient removal levels that are set as goals in the City's current permit and are anticipated to be required limits when the permit is renewed in 2018, and to provide associated cost estimates in 2014 dollars.

During preparation of this report, items of equipment were discovered that are either well beyond their useful lives or are not operating adequately. They should be added to a schedule for replacement in the near future and are shown in the following table.

Table 19: Equipment Recommended for Replacement

Item	Installation Year
Influent FMC Linkbelt screen	1978
Influent Fairbanks Morse pumps	1978
Primary sedimentation basin drives	1962
Primary sludge Moyno pumps	1979
Effluent Fairbanks Morse pumps	1977
Fairbanks Morse WAS pumps	1977
Gas mixing system - dryers	2002
Fairbanks Morse/Wemco digested sludge recirculation pumps	1977

Table 20 presents a summary of the costs for the evaluated nutrient removal treatment alternatives, including an annualized cost over a 20 year period with 4% interest.

Table 20: Treatment Alternative Estimated Cost Summary

Alternative	Estimated Capital Cost	Estimated Annual O&M Cost	Estimated Total Annualized Cost
2	$26,626,000	$1,796,000	$3,755,200
3	$18,270,000	$1,522,000	$2,866,400

Other economic factors which will require consideration are the current resources, rate structures, and demands on funding. Non-economic factors to consider in the selection of an alternative include the following:

- A phased approach to plant modifications to comply with more stringent regulations in the future.
- Room for future expansion (for nutrient removal or capacity upgrades) on the existing site.
- A reliable treatment process for the wastewater treatment facility.
- Increased solids production with aerobic sludge digestion and a change to current contracts with sludge haulers.
- Potential changes in technology.

According to the US Census, the 2013 median household income was $36,235, based on 9,845 households. Using the annualized costs for construction and operation, the treatment options result in a primary municipal screen up to 1.1% per household. This is not deemed a substantial economic impact according to the strictest interpretation of the EPA Interim Guidance for Water Quality Standards, but the cost for nutrient removal will have a significant effect on user fees.

Because it has been indicated by KDHE that nutrient limits will be imposed, either as goals or effluent limits in the City's 2018 permit, the City of Emporia should begin plans for financing improvements with construction to begin in the year 2017.

Appendix A

NPDES Permit

-COPY-

Kansas Permit No.: M-NE24-I001

Federal Permit No.: KS0046728

KANSAS WATER POLLUTION CONTROL PERMIT AND
AUTHORIZATION TO DISCHARGE UNDER
THE NATIONAL POLLUTANT DISCHARGE
ELIMINATION SYSTEM

Pursuant to the Provisions of Kansas Statutes Annotated 65-164 and 65-165, the Federal Water Pollution Control Act as amended, (33 U.S.C. 1251 et seq; the "Act"),

Owner:	Emporia, City of
Owner's Address:	P.O. Box 928 Emporia, Kansas 66801
Facility Name:	Emporia Wastewater Treatment Facility
Facility Location:	1 Gavin Road Emporia, Kansas 66801 SE¼, SE¼, NE¼ & NE¼, NE¼, SE¼ Section 22, and SW¼ SW¼, NW¼ & NW¼, NW¼, SW¼ Section 23 Township 19S, Range 11E Lyon County, Kansas
Facility:	Latitude: 38.38385 Longitude: -96.17140
Outfall:	Latitude: 38.38128 Longitude: -96.17212
Receiving Stream:	Cottonwood River
Basin:	Neosho River Basin

is authorized to discharge from the wastewater treatment facility described herein, in accordance with effluent limits and monitoring requirements as set forth herein.

This permit is effective May 1, 2013, supersedes the previously issued water pollution control permit M-NE24-I001, and expires April 30, 2018.

FACILITY DESCRIPTION:

1. Lift Station
2. Bar screen
3. Grit Removal Chamber
4. Primary Sedimentation Tanks
5. Settled Sewage Lift Station
6. Activated Sludge Basins
7. Intermediate Clarifiers
8. Trickling Filters
9. Final Clarifiers
10. Ultraviolet Disinfection
11. Effluent Lift Station
12. Effluent Aeration
13. Sludge Thickening
14. Anaerobic Digesters
15. Sludge Belt Filter Press
16. Peak Flow Presedimentation Basin
17. Peak Flow Holding Basin
18. Design Flow = 4.6 MGD

PROJECTED limits

Total phosphorus - 1 ppm

Nitrogen - 10 ppm

Robert Moser

Secretary, Kansas Department of Health and Environment

April 25, 2013
Date

A. EFFLUENT LIMITS AND MONITORING REQUIREMENTS

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in this permit. The effluent limits shall become effective on the dates specified herein. Such discharges shall be controlled, limited, and monitored by the permittee as specified. There shall be no discharge of floating solids or visible foam in other than trace amounts.

Monitoring reports shall be submitted on or before the 28th day of the following month. In the event no discharge occurs, written notification is still required.

Parameter	Final Limits	Measurement Frequency	Sample Type
Monitoring Location 001AG (EDMR code: INF001AG) - Influent to Treatment Plant			
Biochemical Oxygen Demand (5-Day)-mg/l	Monitor	Weekly	24-Hour Composite
Total Suspended Solids-mg/l	Monitor	Weekly	24-Hour Composite
Total Phosphorus (as P)- mg/l	Monitor	Weekly	24-Hour Composite
Total Kjeldahl Nitrogen (as N)-mg/l	Monitor	Weekly	24-Hour Composite
Outfall 001A1 (EDMR code: EFF001A1) - Effluent at Effluent Sampling Building			
Biochemical Oxygen Demand (5-Day) *		Weekly	24-Hour Composite
Weekly Average-mg/l	45		
Monthly Average-mg/l	30		
Total Suspended Solids *		Weekly	24-Hour Composite
Weekly Average-mg/l	45		
Monthly Average-mg/l	30		
pH - Standard Units	6.0-9.0	Weekly	Grab
Ammonia - mg/l (as N)		Weekly	24-Hour Composite
January, February and December			
Daily Maximum	9.1		
Monthly Average	7.1		
March, April and October			
Daily Maximum	9.1		
Monthly Average	4.3		
May and September			
Daily Maximum	9.1		
Monthly Average	2.9		
June, July and August			
Daily Maximum	9.1		
Monthly Average	2.2		

A. EFFLUENT LIMITS AND MONITORING REQUIREMENTS (continued)

November			
Daily Maximum	9.1		
Monthly Average	6.7		
E. coli - Colonies/100 ml		Weekly	Grab
April through October			
Weekly Geometric Average	9032		
Monthly Geometric Average	427		
November through March			
Monthly Geometric Average	3843		
Dissolved Oxygen-mg/l	Monitor	Weekly	Grab
Total Kjeldahl Nitrogen (as N) - mg/l**	Monitor	Weekly	24-Hour Composite
Nitrate (NO_3) + Nitrite (NO_2) as N-mg/l**	Monitor	Weekly	24-Hour Composite
Total Nitrogen (as N)-mg/l** and *** (TKN + NO2 + NO3)	Calculate	Weekly	Calculate
Total Nitrogen (as N)-lbs/day (TKN + NO2 + NO3)	Calculate	Weekly	Calculate
Total Phosphorus (as P)-mg/l***	Monitor	Weekly	24-Hour Composite
Total Phosphorus (as P)-lbs/day	Calculate	Weekly	Calculate
Whole Effluent Toxicity - See Supplemental Conditions F.1.			
Priority Pollutant Scan - See Supplemental Conditions F.2.			
Flow to River - MGD	Monitor	Daily	Meter

Peak Flow Holding Basin

Discharges from the Peak Flow Holding Basin shall be controlled by and reported pursuant to paragraphs 9 and 10 of the Standard Conditions.

* Minimum removal of 85% required for Total Suspended Solids and Biochemical Oxygen Demand (5-Day).

** Permittee shall sample for these tests on the same day and calculate the total nitrogen only when both test values are available. The Minimum Reportable Limit (MRL) for TKN is 1 mg/l and for nitrate + nitrite is 0.1 mg/l. Values less than the MRL shall be reported using the less than sign (<) with the MRL value but for purposes of calculating and reporting the total nitrogen result, less than values shall be defaulted to zero.

*** See Special Conditions.

B. STANDARD CONDITIONS

In addition to the specified conditions stated herein, the permittee shall comply with the attached Standard Conditions dated August 1, 2010.

C. SLUDGE REQUIREMENTS

Sludge disposal shall be in accordance with the 40 CFR Part 503 Sludge Regulations.

D. PRETREATMENT PROGRAM

The permittee shall implement and administer the pretreatment program in accordance with the General Pretreatment Regulations 40 CFR Part 403, as approved by the Kansas Department of Health and Environment or the Environmental Protection Agency.

E. SCHEDULE OF COMPLIANCE

None

F. SPECIAL CONDITIONS

The permittee will operate the treatment facility to maximize the level of nutrient removal with the goal of achieving the following target effluent levels:

A. Total Nitrogen ≤ 10.0 mg/l as an annual average.
B. Total Phosphorus ≤ 1.0 mg/l as an annual average.

These target values are not to be considered as effluent limits for this permit. KDHE reserves the right to reopen this permit to impose limits for nutrients pursuant to Kansas law when such criteria are adopted in the Kansas Surface Water Quality Standards.

G. SUPPLEMENTAL CONDITIONS

1. Whole Effluent Toxicity:

a. Chronic Whole Effluent Toxicity (WET) testing on a 24-hr composite sample of the effluent shall be conducted once in calendar year 2013 and annually thereafter. The 25% Inhibition Concentration, IC25, shall be equal to or greater than 26% effluent. Test results less than 26% are violations of this permit. The test procedures shall use the seven day static renewal test method in accordance with the EPA document, Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, fourth edition, October 2002 using test organisms *Pimephales promelas* (fathead minnow) and *Ceriodaphnia dubia* (water flea) within a dilution series containing 0%, 15%, 26%, 45%, 75%, and 100% effluent. KDHE reserves the right to increase or decrease testing frequency based upon compliance history and toxicity testing results.

b. If the WET test results indicate the IC25 is equal to or greater than 26% effluent, the effluent has passed the toxicity test and a copy of the test report shall be due with the next scheduled Discharge Monitoring Report.

c. If the WET test results indicate the IC25 is less than 26% effluent, the effluent has failed the toxicity test and the permittee shall immediately notify KDHE by telephone at (785) 296-5517 and submit to KDHE a copy of the test report within five days of receipt of the information. KDHE reserves the right to require the permittee to take such actions as are reasonable to identify and remedy any identified or predicted toxic conditions in the receiving stream outside of the mixing zone which is caused by the permittee's effluent.

d. Permittee shall also test a portion of the same effluent sample used for the WET test for the following substances (required minimum reportable detection levels are in parenthesis):

Antimony (10 µg/L)*	Nickel (10 µg/L)*
Arsenic (10 µg/L)*	Selenium (5 µg/L)*
Beryllium (5 µg/L)*	Silver (2 µg/L)*
Cadmium (2 µg/L)*	Thallium (10 µg/L)*
Chromium (10 µg/L)*	Zinc (20 µg/L)*
Copper (10 µg/L)*	Ammonia as "N" (0.2 mg/l)
Lead (5 µg/L)*	Total Hardness as CaCO3 mg/l
Mercury (0.2 µg/L-Cold Vapor Method)	pH

* Parameter shall be tested and reported as "total recoverable" metals.

e. The permittee shall coordinate sampling for this test with other requirements of this permit. The permittee shall use a laboratory approved by KDHE for Whole Effluent Toxicity testing.

2. Permittee shall conduct a Priority Pollutant Scan on the effluent from Outfall 001A1 for the parameters listed in Table I, Priority Pollutant Scan, as noted below. The Priority Pollutant Scan shall be conducted during the last calendar year of this permit and the results reported to KDHE with the next Discharge Monitoring Report following receipt of the results but not later than March 31, 2018. Sample type shall be 24-hour composites except for Volatiles which shall be a grab sample. See Supplemental Condition G.1.d. for minimum detection limits for certain metals in the Priority Pollutant Scan.

Table I
Priority Pollutant Scan

Metals
- Total Recoverable Arsenic (µg/l)
- Total Recoverable Beryllium (µg/l)
- Total Recoverable Cadmium (µg/l)
- Total Recoverable Chromium (µg/l)
- Total Recoverable Copper (µg/l)
- Total Recoverable Lead (µg/l)
- Total Mercury (µg/l)
- Total Recoverable Molybdenum (µg/l)
- Total Recoverable Potassium (µg/l)
- Total Recoverable Nickel (µg/l)
- Total Recoverable Selenium (µg/l)
- Total Recoverable Silver (µg/l)
- Total Recoverable Thallium (µg/l)
- Total Recoverable Zinc (µg/l)

Pesticides
- Aldrin (mg/l)
- Alpha-BHC (mg/l)
- Beta-BHC (mg/l)
- Gamma-BHC (mg/l)
- Delta-BHC (mg/l)
- Chlordane (mg/l)
- 4,4-DDT (mg/l)
- 4,4-DDD (mg/l)
- 4,4-DDE (mg/l)
- Dieldrin (mg/l)
- Alpha-endosulfan (mg/l)
- Beta-endosulfan (mg/l)
- Endosulfan sulfate (mg/l)
- Endrin (mg/l)
- Endrin aldehyde (mg/l)
- Heptachlor (mg/l)
- Heptachlor epoxide (mg/l)
- Toxaphene (mg/l)
- Malathion (mg/l)
- Diazinon (mg/l)

Polychlorinated Biphenyls (mg/l)
- PCB-1242
- PCB-1254
- PCB-1221
- PCB-1232
- PCB-1248
- PCB-1260
- PCB-1016

Priority Pollutant Scan (continued)

Base/Neutral
- Acenaphthene (mg/l)
- Acenaphtylene (mg/l)
- Anthracene (mg/l)
- Benzidine (mg/l)
- Benzo(a) anthracene (mg/l)
- Benzo(a)pyrene (mg/l)
- 3,4-benzofluoranthene (mg/l)
- Benzo (ghi) perylene (mg/l)
- Benzo (b) fluoranthene (mg/l)
- Bis(2-chloroethoxy)methane (mg/l)
- Bis(2-chloroethyl)ether (mg/l)
- Bis(2-ethylhexyl)phthalate (mg/l)
- Bis(2-chloroisopropyl) ether (mg/l)
- 1,2-diphenylhydrazine (mg/l)
- Fluoranthene (mg/l)
- Fluorene (mg/l)
- Nitrobenzene (mg/l)
- N-nitrosodimethylamine (mg/l)
- N-nitrosodi-n-propylamine (mg/l)
- N-nitrosodiphenylamine (mg/l)
- Phenanthrene (mg/l)
- Pyrene (mg/l)
- 1,2,4-trichlorobenzene (mg/l)
- 4-bromophenyl phenyl ether (mg/l)
- Butyl benzyl phthalate (mg/l)
- 2-chloronaphthalene (mg/l)
- 4-chlorophenyl phenyl ether (mg/l)
- Chrysene (mg/l)
- Dibenzo(a,h) anthracene (mg/l)
- 1,2-dichlorobenzene (mg/l)
- 1,3-dichlorobenzene (mg/l)
- 1,4-dichlorobenzene (mg/l)
- 3,3-dichlorobenzidine (mg/l)
- Dimethyl phthalate (mg/l)
- Diethyl phthalate (mg/l)
- Di-n-butyl phthalate (mg/l)
- 2,4-dinitrotoluene (mg/l)
- 2,6-dinitrotoluene (mg/l)
- Di-n-octyl phthalate (mg/l)
- Hexachlorobenzene (mg/l)
- Hexachlorobutadiene (mg/l)
- Hexachlorocyclopentadiene (mg/l)
- Hexachloroethane (mg/l)
- Indeno (1,2,3-cd) pyrene (mg/l)
- Naphthalene (mg/l)
- Isophorone (mg/l)

Priority Pollutant Scan (continued)

Acid Compounds
- 2-chlorophenol (mg/l)
- 2,4-dichlorophenol (mg/l)
- 2,4-dimethylphenol (mg/l)
- 2,4-dinitrophenol (mg/l)
- 2-nitrophenol (mg/l)
- 4-nitrophenol (mg/l)
- Parachlorometa cresol (mg/l)
- Pentachlorophenol (mg/l)
- Phenol (mg/l)
- 4,6-dinitro-o-cresol (mg/l)
- 2,4,6-trichlorophenol (mg/l)

Volatiles
- Acrolein (mg/l)
- Acrylonitrile (mg/l)
- Benzene (mg/l)
- Bromoform (mg/l)
- Carbon Tetrachloride (mg/l)
- Chlorobenzene (mg/l)
- Chlorodibromomethane (mg/l)
- Chloroethane (mg/l)
- 2-chloroethylvinyl ether (mg/l)
- Chloroform (mg/l) (mg/l)
- Dichlorobromomethane (mg/l)
- 1,1-dichloroethane (mg/l)
- 1,2-dichloroethane (mg/l)
- 1,1-dichloroethylene (mg/l)
- 1,2-dichloropropane (mg/l)
- 1,3-dichloropropylene (mg/l)
- Ethylbenzene (mg/l)
- Methyl bromide (mg/l)
- Methyl chloride (mg/l)
- Methylene chloride (mg/l)
- 1,1,2,2-tetrachloroethane (mg/l)
- Tetrachloroethylene (mg/l)
- Toluene (mg/l)
- 1,2 trans-dichloroethylene (mg/l)
- 1,1,1-trichloroethane (mg/l)
- 1,1,2-trichloroethane (mg/l)
- Trichloroethylene (mg/l)
- Vinyl chloride (mg/l)

Miscellaneous
- Total Cyanide (mg/l)*
- Total Phenols (mg/l)

* The total cyanide analysis must include preliminary treatment of the sample to avoid NO_2^- interference. Addition of sulfamic acid to the sample before distillation can prevent such interference, see Standard Methods for the Examination of Water and Wastewater, 18th Edition, 4500-CN^- B. Preliminary Treatment of Samples.

STANDARD CONDITIONS FOR
KANSAS WATER POLLUTION CONTROL AND
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMITS

1. Representative Sampling and Discharge Monitoring Report Submittals:

   A. Samples and measurements taken as required herein shall be representative of the quality and quantity of the monitored discharge. Test results shall be recorded for the day the samples were taken. If sampling for a parameter was conducted across more than one calendar day, the test results may be recorded for the day sampling was started or ended. All samples shall be taken at the locations designated in this permit, and unless specified, at the outfall/monitoring location(s) before the wastewater joins or is diluted by any other water or substance.

   B. Monitoring results shall be recorded and reported on forms acceptable to the Division and postmarked no later than the 28th day of the month following the completed reporting period. Signed and certified copies of these, prepared in accordance with KAR 28-16-59, and all other reports required herein, may be FAXed to 785.296.0086, e-mailed as scanned attachments to dmr4kdhe@kdheks.gov , or sent by U.S. mail to:

      Kansas Department of Health & Environment
      Bureau of Water-Technical Services Section
      1000 SW Jackson Street, Suite 420
      Topeka, KS 66612-1367

2. Definitions:

   A. Unless otherwise specifically defined in this permit, the following definitions apply:

      1. The "Daily Maximum" is the total discharge by weight or average concentration, measurement taken, or value calculated during a 24-hour period. The parameter, pH, is limited as a range between and including the values shown.

      2. The "Weekly Average" is the arithmetic mean of the value of test results from samples collected, measurements taken or values calculated during four monitoring periods in each month consisting of calendar days 1-7, 8-14, 15-21 and 22 through the end of the month.

      3. The "Monthly Average", other than for E. coli bacteria, is the arithmetic mean of the value of test results from samples collected, measurements taken or values calculated during a calendar month. The monthly average is determined by the summation of all calculated values or measured test results divided by the number of calculated values or test results reported for that parameter during the calendar month. The monthly average for E. coli bacteria is the geometric average of the value of the test results from samples collected in a calendar month. The geometric average can be calculated by using a scientific calculator to multiply all the E. coli test results together and then taking the nth root of the product where n is the number of test results. Non-detect values shall be reported using the less than symbol (<) and the minimum detection or reportable value. To calculate average values, non-detects shall be defaulted to zero (or one for geometric averages). Greater than values shall be reported using the greater than symbol (>) and the reported value. To calculate average values, the greater than reported value shall be used in the averaging calculation.

   B. A "grab sample" is an individual sample collected in less than 15 minutes. A "composite sample" is a combination of individual samples in which the volume of each individual sample is proportional to the flow, or the sample frequency is proportioned to the flow rate over the sample period, or the sample frequency is proportional to time.

   C. The terms "Director", "Division", and "Department" refer to the Director, Division of Environment, Kansas Department of Health and Environment, respectively.

   D. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of an in-plant diversion. Severe property damage does not mean economic loss caused by delays in production.

   E. "Bypass" means the intentional diversion of waste streams from any portion of the treatment facility.

3. Schedule of Compliance: No later than 14 calendar days following each date identified in the "Schedule of Compliance," the permittee shall submit via mail, e-mail or fax per paragraph 1.B above, either a report of progress or, in the case of specific action being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements, or, if there are no more scheduled requirements, when such noncompliance will be corrected.

4. Test Procedures: All analyses required by this permit shall conform to the requirements of 40 CFR Part 136, unless otherwise specified, and shall be conducted in a laboratory accredited by the Department. For each measurement or sample, the permittee shall record the exact place, date, and time of measuring/sampling; the date and time of the analyses, the analytical techniques or methods used, minimum detection or reportable level, and the individual(s) who performed the measuring/sampling and analysis and, the results. If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved procedures, the results shall be included in the Discharge Monitoring Report form required in 1.B. above. Such increased frequencies shall also be indicated.

5. Change in Discharge: All discharges authorized herein shall be consistent with the permit requirements. The discharge of any pollutant not authorized by this permit or of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of this permit. Any anticipated facility expansions, production or flow increases, or production or wastewater treatment system modifications which result in a new, different, or increased discharge of pollutants shall be reported to the Division at least one hundred eighty (180) days before such change.

6. Facilities Operation: The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the requirements of this permit and Kansas and Federal law. Proper operation and maintenance also include adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the requirements of this permit. The permittee shall take all necessary steps to minimize or prevent any adverse impact to human health or the environment resulting from noncompliance with any effluent limits specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge. When necessary to maintain compliance with the permit requirements, the permittee shall halt or reduce those activities under its control which generate wastewater routed to this facility.

7. Incidents:

   "Collection System Diversion" means the diversion of wastewater from any portion of the collection system.

   "In-Plant Diversion" means routing the wastewater around any treatment unit in the treatment facility through which it would normally flow.

   "In-Plant Flow Through" means an incident in which the wastewater continues to be routed through the equipment even though full treatment is not being accomplished because of equipment failure for any reason.

   "Spill" means any discharge of wastewater, sludge or other materials from the treatment facility other than effluent or as more specifically described by other "Incidents" terms.

   "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance or anticipated noncompliance with permit effluent limits because of factors beyond the reasonable control of the permittee, as described by 40 C.F.R. 122.41(n).

8. Diversions not Exceeding Limits: The permittee may allow any diversion to occur which does not cause effluent limits to be exceeded, but only if it also is for essential maintenance to assure efficient operation. Such diversions are not subject to the Incident Reporting requirements shown below.

9. Prohibition of an In-Plant Diversion: Any in-plant diversion from facilities necessary to maintain compliance with this permit is prohibited, except: (a) where the in-plant diversion was unavoidable to prevent loss of life, personal injury, or severe property damage; (b) where there were no feasible alternatives to the in-plant diversion, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime and (c) the permittee submitted a notice as required in the Incident Reporting paragraph below. The Director may approve an anticipated in-plant diversion, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above.

10. Incident Reporting: The permittee shall report any unanticipated collection system diversion, in-plant diversion, in-plant flow through occurrence, spill, upset or any violation of a permitted daily maximum limit within 24 hours from the time the permittee became aware of the incident. A written submission shall be provided within 5 days of the time the permittee became aware of the incident. The written submission shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times; and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance. An Incident Report form is available at www.kdheks.gov/water/tech.html.

    For an anticipated incident or any planned changes or activities in the permitted facility that may result in noncompliance with the permit requirements, the permittee shall submit written notice, if possible, at least ten days before the date of the event.

    For other noncompliance, the above information shall be provided with the next Discharge Monitoring Report.

11. Removed Substances: Solids, sludges, filter backwash, or other pollutants removed in the course of treatment of water shall be utilized or disposed of in a manner acceptable to the Division.

12. Power Failures: The permittee shall provide an alternative power source sufficient to operate the wastewater control facilities or otherwise control pollution and all discharges upon the loss of the primary source of power to the wastewater control facilities.

13. Right of Entry: The permittee shall allow authorized representatives of the Division of Environment or the Environmental Protection Agency upon the presentation of credentials, to enter upon the permittee's premises where an effluent source is located, or in which are located any records required by this permit, and at reasonable times, to have access to and copy any records required by this permit, to inspect any facilities, monitoring equipment or monitoring method required in this permit, and to sample any influents to, discharges from or materials in the wastewater facilities.

14. Transfer of Ownership: The permittee shall notify the succeeding owner or controlling person of the existence of this permit by certified letter, a copy of which shall be forwarded to the Division. The succeeding owner shall secure a new permit. This permit is not transferable to any person except after notice and approval by the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary.

15. Records Retention: Unless otherwise specified, all records and information resulting from the monitoring activities required by this permit, including all records of analyses and calibration and maintenance of instruments and recordings from continuous monitoring instruments, shall be retained for a minimum of 3 years, or longer if requested by the Division. Biosolids/sludge records and information are required to be kept for a minimum of 5 years, or longer if requested by the Division. Groundwater monitoring data, including background samples results, shall be kept for the life of the facility regardless of ownership.

16. Availability of Records: Except for data determined to be confidential under 33 USC Section 1318, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. Effluent data shall not be considered confidential. Knowingly making any false statement on any such report or tampering with equipment to falsify data may result in the imposition of criminal penalties as provided for in 33 USC Section 1319 and KSA 65-170c.

17. Permit Modifications and Terminations: As provided by KAR 28-16-62, after notice and opportunity for a hearing, this permit may be modified, suspended or revoked or terminated in whole or in part during its term for cause as provided, but not limited to those set forth in KAR 28-16-62 and KAR 28-16-28b through g. The permittee shall furnish to the Director, within a reasonable amount of time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish upon request, copies of all records required to be kept by this permit. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

18. Toxic Pollutants: Notwithstanding paragraph 17 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified at such effluent standards) is established under 33 USC Section 1317(a) for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition. Nothing in this permit relieves the permittee from complying with federal toxic effluent standards as promulgated pursuant to 33 USC Section 1317.

19. Administrative, Civil and Criminal Liability: The permittee shall comply with all requirements of this permit. Except as authorized in paragraph 9 above, nothing in this permit shall be construed to relieve the permittee from administrative, civil or criminal penalties for noncompliance as provided for in KSA 65-161 et seq., and 33 USC Section 1319.

20. Oil and Hazardous Substance Liability: Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities or penalties to which the permittee is or may be subject to under 33 USC Section 1321 or KSA 65-164 et seq. A municipal permittee shall promptly notify the Division by telephone upon discovering crude oil or any petroleum derivative in its sewer system or wastewater treatment facilities.

21. Industrial Users: A municipal permittee shall require any industrial user of the treatment works to comply with 33 USC Section 1317, 1318 and any industrial user of storm sewers to comply with 33 USC Section 1308.

22. Property Rights: The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights nor any infringements of or violation of federal, state or local laws or regulations.

23. Operator Certification: The permittee shall, if required, ensure the wastewater facilities are under the supervision of an operator certified by the Department. If the permittee does not have a certified operator or loses its certified operator, appropriate steps shall be taken to obtain a certified operator as required by KAR 28-16-30 et seq.

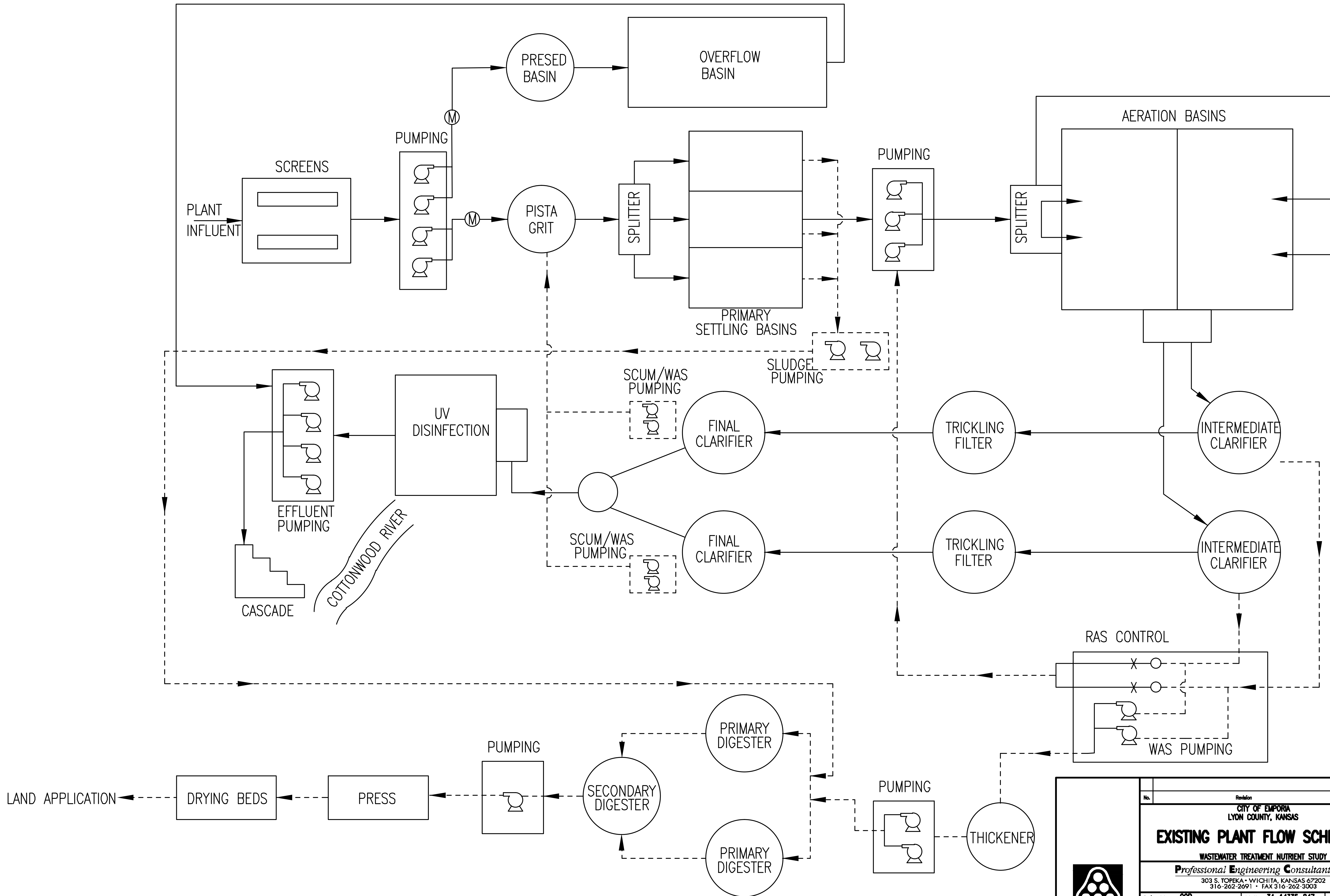
24. Severability: The provisions of this permit are severable. If any provision of this permit or any circumstance is held invalid, the application of such provision to other circumstances and the remainder of the permit shall not be affected thereby.

25. Removal from Service: The permittee shall inform the Division at least three months before a pumping station, treatment unit, or any other part of the treatment facility permitted by this permit is to be removed from service and shall make arrangements acceptable to the Division to decommission the facility or part of the facility being removed from service such that the public health and waters of the state are protected.

26. Duty to Reapply: A permit holder wishing to continue any activity regulated by this permit after the expiration date, must apply for a new permit at least 180 days prior to expiration of the permit.

Appendix B

Existing Facility Schematic



No.	Revision	By	Date

CITY OF EMPORIA
LYON COUNTY, KANSAS

EXISTING PLANT FLOW SCHEMATIC

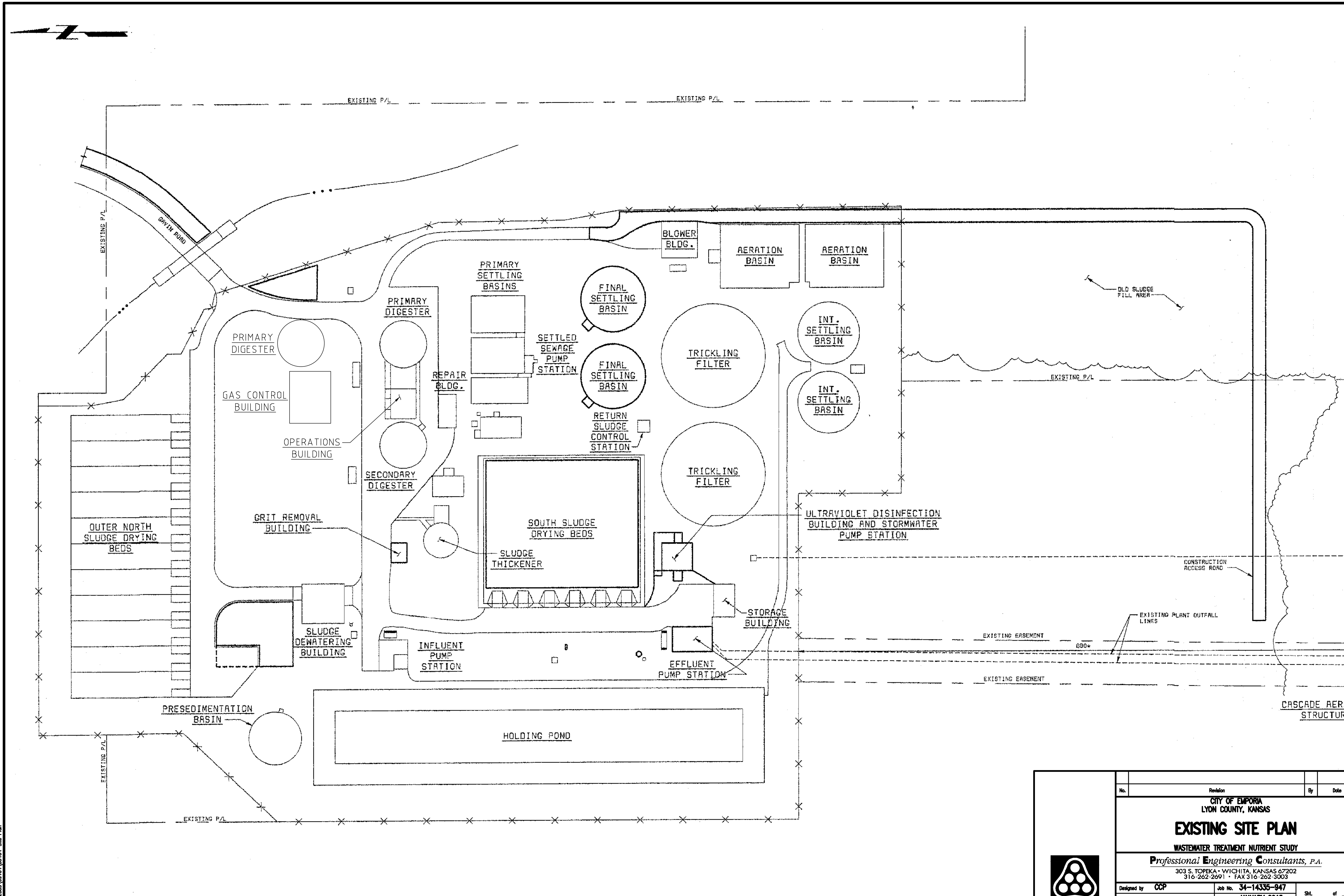
WASTEWATER TREATMENT NUTRIENT STUDY

Professional Engineering Consultants, P.A.
303 S. TOPEKA • WICHITA, KANSAS 67202
316-262-2691 • FAX 316-262-3003

Designed by CCP | Job No. 34-14335-947
Drawn by | Date JANUARY 2015
Sht. of ___

Appendix C

Site Plans



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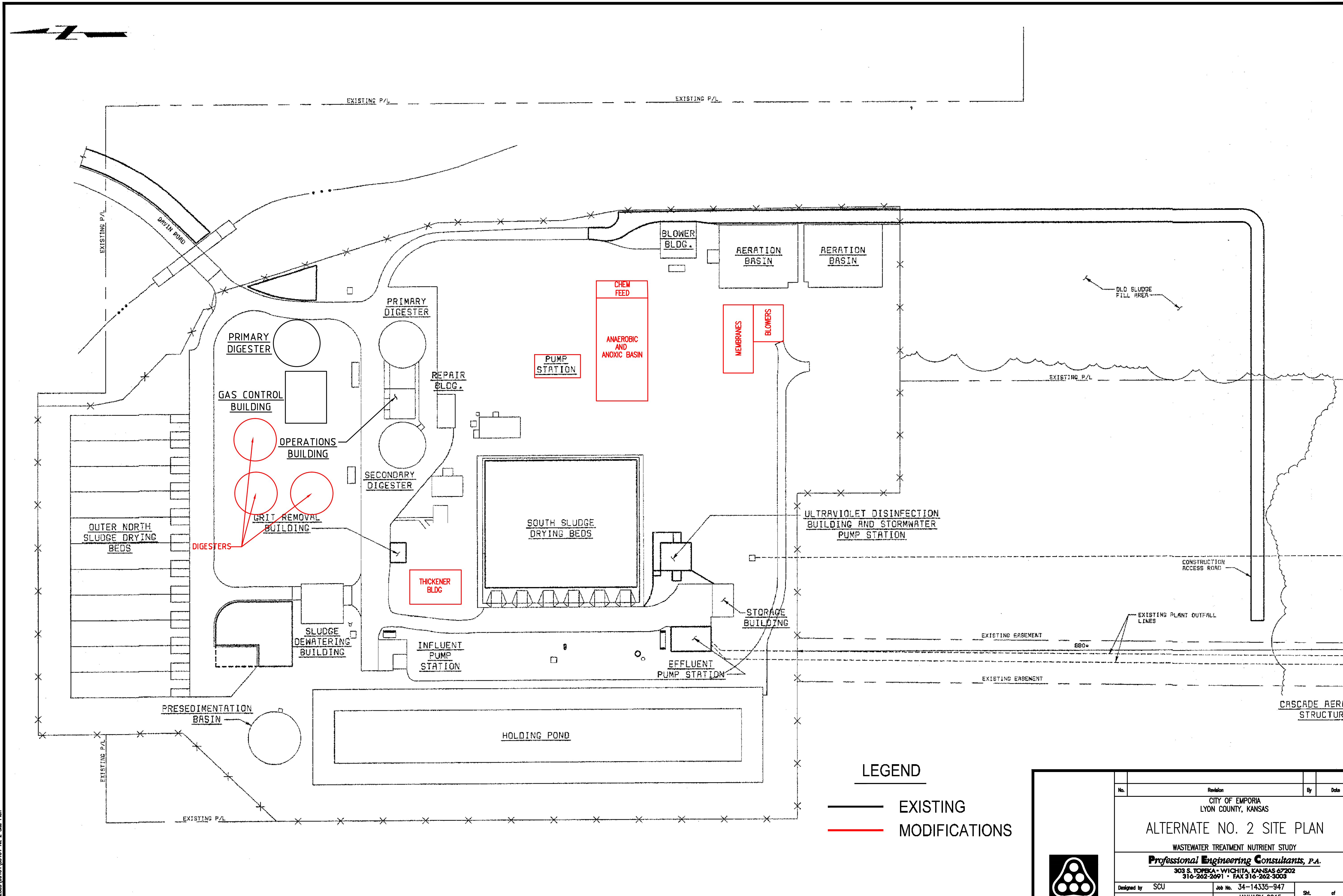
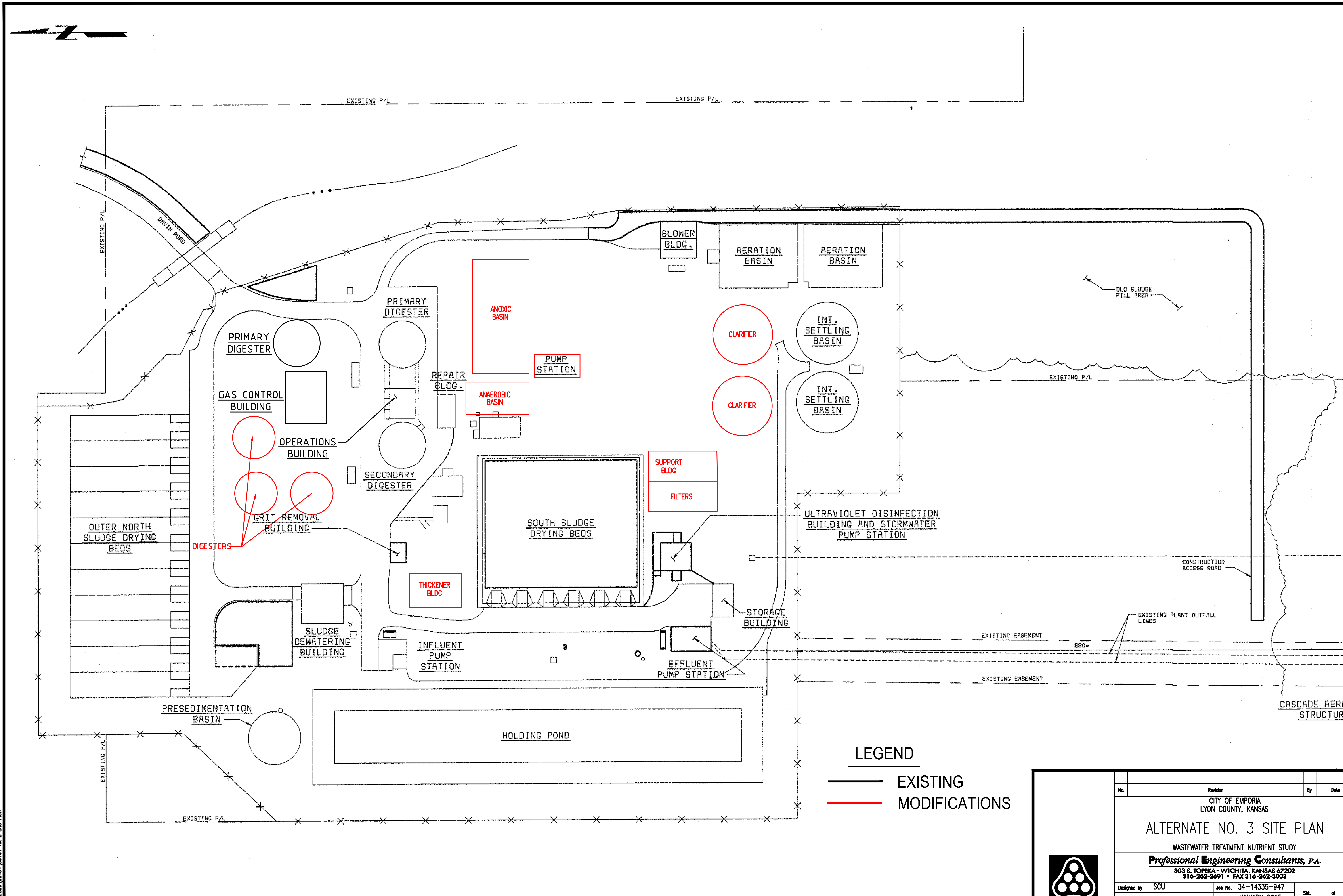


EXISTING P/L
EXISTING P/L
DAVIN ROAD
BLOWER BLDG.
AERATION BASIN
AERATION BASIN
OLD SLUDGE FILL AREA
CHEM FEED
ANAEROBIC AND ANOXIC BASIN
MEMBRANES
BLOWERS
PUMP STATION
PRIMARY DIGESTER
PRIMARY DIGESTER
REPAIR BLDG.
GAS CONTROL BUILDING
OPERATIONS BUILDING
SECONDARY DIGESTER
GRIT REMOVAL BUILDING
EXISTING P/L
OUTER NORTH SLUDGE DRYING BEDS
DIGESTERS
SOUTH SLUDGE DRYING BEDS
ULTRAVIOLET DISINFECTION BUILDING AND STORMWATER PUMP STATION
CONSTRUCTION ACCESS ROAD
THICKENER BLDG
STORAGE BUILDING
EXISTING PLANT OUTFALL LINES
EXISTING EASEMENT
680±
EXISTING EASEMENT
SLUDGE DEWATERING BUILDING
INFLUENT PUMP STATION
EFFLUENT PUMP STATION
CASCADE AERAT STRUCTURE
PRESEDIMENTATION BASIN
HOLDING POND
EXISTING P/L
EXISTING P/L
LEGEND
EXISTING
MODIFICATIONS
No. Revision By Date
CITY OF EMPORIA
LYON COUNTY, KANSAS
ALTERNATE NO. 2 SITE PLAN
WASTEWATER TREATMENT NUTRIENT STUDY
Professional Engineering Consultants, P.A.
303 S. TOPEKA • WICHITA, KANSAS 67202
316-262-2691 • FAX 316-262-3003
Designed by SCU
Job No. 34-14335-947
Drawn by
Date JANUARY 2015
Sht. of



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Appendix D

Detailed Cost Estimates

Emporia Wastewater Treatment Facility Study
PEC PROJECT NO. 34-14335-000-0947

Cost Evaluation - Treatment Alternative No. 2
OPINION OF COST
Date Jan-15

New Primary Anaerobic and Anoxic Basins

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
15700	CY	Excavation	$	10	CY	$157,000	
1350	CY	Slab	$	550	CY	$742,500	
1115	CY	Walls	$	800	CY	$892,000	
15	EA	Mixers	$	25,000	EA	$375,000	
1	LS	Piping	$	150,000	LS	$150,000	
		SUB TOTAL					**$2,316,500**

Membrane System

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
500	CY	Excavation	$	10	CY	$5,000	
310	CY	Concrete - Slab	$	550	CY	$170,500	
510	CY	Concrete - Walls	$	800	CY	$408,000	
1500	SF	Building	$	300	SF	$450,000	
2	EA	Blowers	$	65,000	EA	$130,000	
2	EA	Internal recycle pumps	$	15,000	EA	$30,000	
1	EA	Membrane system	$	7,060,000	EA	$7,060,000	
1	LS	Piping & valves	$	50,000	LS	$50,000	
		SUB TOTAL					**$8,303,500**

Ferric Feed System

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
200	CY	Excavation	$	10	CY	$2,000	
700	SF	Chemical Feed Building	$	200	SF	$140,000	
50	CY	Concrete Slab	$	550	CY	$27,500	
1	LS	Chemical Feed Equipment	$	100,000	LS	$100,000	
200	LF	Piping	$	100	LF	$20,000	
		SUB TOTAL					**$289,500**

Recycle Pumping

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
1200	CY	Excavation	$	10	CY	$12,000	
50	CY	Slab	$	550	CY	$27,500	
75	CY	Walls	$	800	CY	$60,000	
50	CY	Elevated Slab	$	900	CY	$45,000	
4	EA	Recycle Pumps	$	75,000	EA	$300,000	
1	EA	Hoist/Monorail	$	60,000	EA	$60,000	
1	LS	Level Monitoring	$	50,000	LS	$50,000	
4	EA	Flowmeter	$	10,000	EA	$40,000	
1	LS	Piping	$	60,000	LS	$60,000	
		SUB TOTAL					**$654,500**

Rotary Drum Thickener

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
1500	CY	Excavation	$	10	CY	$15,000	
2500	SF	Thickener Building	$	200	SF	$500,000	
1	LS	Thickener Equipment	$	100,000	EA	$100,000	
1	LS	Piping	$	60,000	LS	$60,000	
		SUB TOTAL					**$675,000**

Aerobic Digestion

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
1000	CY	Excavation	$	10	CY	$10,000	
1	LS	Anaerobic Digester Rehabilitation	$	75,000	LS	$75,000	
400	CY	Concrete Slab	$	550	CY	$220,000	
750	CY	Concrete Walls	$	800	CY	$600,000	
6	EA	Blowers	$	75,000	EA	$450,000	
6	EA	Diffusers	$	30,000	EA	$180,000	
6	EA	Liquid Decanter	$	20,000	EA	$120,000	
6	EA	Sludge Transfer Pumps	$	25,000	EA	$150,000	
		SUB TOTAL					**$1,805,000**

Existing Pumping Improvements

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
4	EA	Influent Pumps	$	75,000	EA	$300,000	
4	EA	Effluent Pumps	$	50,000	EA	$200,000	
		SUB TOTAL					**$500,000**

Electrical Cost

Electrical System

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
1	LS	SCADA System	$	350,000	LS	$350,000	
1	LS	Instrumentation	$	350,000	LS	$350,000	
1	LS	Site Elec. Service	$	300,000	LS	$300,000	
1	LS	Site Elec. Distribution	$	300,000	LS	$300,000	
		SUB TOTAL					**$1,300,000**

Site Work

Site Work

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
1	LS	Demolition	$	150,000	LS	$150,000	
1	LS	Grading/Seeding/Restoration	$	100,000	LS	$100,000	
1	LS	Site Electrical/Lighting	$	150,000	LS	$150,000	
1	LS	Piping	$	150,000	LS	$150,000	
		SUB TOTAL					**$550,000**

Contruction Project Cost

Construction Sub-Total Before Contractor Costs					**$16,394,000**
Contractor Costs					
1 LS	Contractors' Fixed Costs	12.00 %	$1,967,300		
	SUB TOTAL				**$1,967,300**
		OPINION OF CONSTRUCTION COST			**$18,362,000**
	Contingency	25%			**$4,591,000**
	Project Costs	20%			**$3,673,000**
	OPINION OF TOTAL PROJECT COST				**$26,626,000**

Emporia Wastewater Treatment Facility Study
PEC PROJECT NO. 34-14335-000-0947

Cost Evaluation - Treatment Alternative No. 3
OPINION OF COST
Date Jan-15

New Anaerobic and Anoxic Basins

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
12230	CY	Excavation	$	10	CY	$122,300	
1045	CY	Slab	$	550	CY	$574,800	
1005	CY	Walls	$	800	CY	$804,000	
15	EA	Mixers	$	20,000	EA	$300,000	
1	LS	Piping	$	200,000	LS	$200,000	
		SUB TOTAL					**$2,001,100**

New Sedimentation Basins

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
6200	CY	Excavation	$	10	CY	$62,000	
285	CY	Concrete Slabs	$	550	CY	$156,800	
600	CY	Concrete Walls	$	800	CY	$480,000	
2	EA	Clarifier Equipment	$	250,000	EA	$500,000	
2	EA	Density Baffles	$	45,000	EA	$90,000	
2	EA	Troughs	$	100,000	EA	$200,000	
2	EA	Weir and Baffles	$	25,000	EA	$50,000	
		SUB TOTAL					**$1,538,800**

Recycle Pumping

1200	CY	Excavation	$	10	CY	$12,000	
50	CY	Slab	$	550	CY	$27,500	
75	CY	Walls	$	800	CY	$60,000	
50	CY	Elevated Slab	$	900	CY	$45,000	
4	EA	Recycle Pumps	$	75,000	EA	$300,000	
1	EA	Hoist/Monorail	$	60,000	EA	$60,000	
1	LS	Level Monitoring	$	50,000	LS	$50,000	
4	EA	Flowmeter	$	10,000	EA	$40,000	
1	LS	Piping	$	60,000	LS	$60,000	
		SUB TOTAL					**$654,500**

Rotary Drum Thickener

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
1500	CY	Excavation	$	10	CY	$15,000	
2500	SF	Thickener Building	$	200	SF	$500,000	
1	LS	Thickener Equipment	$	100,000	EA	$100,000	
1	LS	Piping	$	60,000	LS	$60,000	
		SUB TOTAL					**$675,000**

Aerobic Digestion

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
1000	CY	Excavation	$	10	CY	$10,000	
1	LS	Anaerobic Digester Rehabilitation	$	75,000	LS	$75,000	
400	CY	Concrete Slab	$	550	CY	$220,000	
750	CY	Concrete Walls	$	800	CY	$600,000	
6	EA	Blowers	$	75,000	EA	$450,000	
6	EA	Diffusers	$	30,000	EA	$180,000	
6	EA	Liquid Decanter	$	20,000	EA	$120,000	
6	EA	Sludge Transfer Pumps	$	25,000	EA	$150,000	
		SUB TOTAL					**$1,805,000**

Existing Pumping Improvements

QUANTITY		DESCRIPTION	UNIT PRICE			AMOUNT	TOTAL
4	EA	Influent Pumps	$	75,000	EA	$300,000	
4	EA	Effluent Pumps	$	50,000	EA	$200,000	
		SUB TOTAL					**$500,000**

Ferric Feed System

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT	TOTAL
200 CY	Excavation	$ 10 CY	$2,000	
700 SF	Chemical Feed Building	$ 200 SF	$140,000	
50 CY	Concrete Slab	$ 550 CY	$27,500	
1 LS	Chemical Feed Equipment	$ 100,000 LS	$100,000	
200 LF	Piping	$ 100 LF	$20,000	
	SUB TOTAL			**$289,500**

Recycle Pumping

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT	TOTAL
300 CY	Excavation	$ 10 CY	$3,000	
60 CY	Concrete Slab	$ 550 CY	$33,000	
4 EA	Recycle Pumps	$ 75,000 EA	$300,000	
1 EA	Hoist/Monorail	$ 60,000 EA	$60,000	
4 EA	Flowmeter	$ 10,000 EA	$40,000	
1 LS	Piping	$ 60,000 LS	$60,000	
	SUB TOTAL			**$496,000**

New Filtration

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT	TOTAL
1500 CY	Excavation	$ 10 CY	$15,000	
70 CY	Concrete Slab	$ 550 CY	$38,500	
120 CY	Concrete Walls	$ 800 CY	$96,000	
2500 SF	Filtration Building	$ 300 SF	$750,000	
4 EA	Blowers	$ 75,000 EA	$300,000	
4 EA	Backwash pumps	$ 35,000 EA	$140,000	
1 LS	Piping	$ 100,000 LS	$100,000	
	SUB TOTAL			**$1,439,500**

Electrical Cost

Electrical System

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT	TOTAL
1 LS	SCADA System	$ 350,000 LS	$350,000	
1 LS	Instrumentation	$ 350,000 LS	$350,000	
1 LS	Site Elec. Service	$ 300,000 LS	$300,000	
1 LS	Site Elec. Distribution	$ 300,000 LS	$300,000	
	SUB TOTAL			**$1,300,000**

Site Work

Site Work

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT	TOTAL
1 LS	Demolition	$ 150,000 LS	$150,000	
1 LS	Grading/Seeding/Restoration	$ 100,000 LS	$100,000	
1 LS	Site Electrical/Lighting	$ 150,000 LS	$150,000	
1 LS	Piping	$ 150,000 LS	$150,000	
	SUB TOTAL			**$550,000**

Contruction Project Cost

Construction Sub-Total Before Contractor Costs				**$11,249,400**
Contractor Costs				
1 LS	Contractors' Fixed Costs	12.00 %	$1,350,000	
	SUB TOTAL			**$1,350,000**
		OPINION OF CONSTRUCTION COST		**$12,600,000**
	Contingency	25%		**$3,150,000**
	Project Costs	20%		**$2,520,000**
	OPINION OF TOTAL PROJECT COST			**$18,270,000**

Emporia Wastewater Treatment Facility Study
PEC PROJECT NO. 34-14335-000-0947

Operation and Maintenance Cost Evaluation - Treatment Alternative No. 2
Date Jan-15

Alternative No.2 - Based on 4.6 MGD Average Flow

Power (Equipment)

Equipment	HP	Hrs/day	$/kW-hr		
Influent Pumping	75	24	0.08	$	39,300
Grit Pump	10	12	0.08	$	2,700
Anaerobic Mixers	20	24	0.08	$	10,500
Anoxic Mixers	20	24	0.08	$	10,500
Pumping to Aerobic Basins	75	24	0.08	$	39,300
Aeration Blowers	400	24	0.08	$	209,200
Membrane Fed Pumping	165	24	0.08	$	86,300
Membrane Permeate Pumping	220	3	0.08	$	14,400
Membrane Air Compressor	40	3	0.08	$	2,700
Membrane Blowers	440	8	0.08	$	76,700
Recycle Pumping	60	24	0.08	$	31,400
Rotary Drum Thickener/Pumping	60	12	0.08	$	15,700
Digester Blowers	200	12	0.08	$	52,300
Belt Filter Press	50	5	0.08	$	5,500

Equipment	kW	Hrs/day	$/kW-hr		
UV	45	24	0.08	$	31,600

Chemicals

Type	lbs/day	$/lb		
Polymer	35	$2.50	$	31,900
Ferric	600	$0.25	$	54,800

Power (Buildings)

$/kW-hr	sq. ft.	kW-hr/ft^2		
0.08	17000	70	$	95,200

Staff

People	$/hr	hrs/wk		
8	28	40	$	466,000

Sludge Disposal	$	230,000
Maintenance	$	200,000
Supplies	$	60,000
Laboratory	$	30,000
Total=	$	1,796,000

Emporia Wastewater Treatment Facility Study
PEC PROJECT NO. 34-14335-000-0947

Operation and Maintenance Cost Evaluation - Treatment Alternative No. 3
Date Jan-15

Alternative No.3 - Based on 4.6 MGD Average Flow

Power (Equipment)

Equipment	HP	Hrs/day	$/kW-hr		
Influent Pumping	75	12	0.08	$	19,700
Grit Pump	10	12	0.08	$	2,700
Anaerobic Mixers	20	12	0.08	$	5,300
Anoxic Mixers	20	24	0.08	$	10,500
Pumping to Aerobic Basins	75	24	0.08	$	39,300
Aeration Blowers	400	24	0.08	$	209,200
Final Clarifiers	10	24	0.08	$	5,300
Recycle Pumps	60	24	0.08	$	31,400
Backwash Pumps	10	12	0.08	$	2,700
Rotary Drum Thickener/Pumping	60	12	0.08	$	15,700
Digester Blowers	200	12	0.08	$	52,300
Digester Decant	20	12	0.08	$	5,300
Belt Filter Press	50	5	0.08	$	5,500

Equipment	kW	Hrs/day	$/kW-hr		
UV	45	24	0.08	$	31,600

Power (Buildings)

$/kW-hr	sq. ft.	kW-hr/ft^2		
0.08	17000	70	$	95,200

Chemicals

Type	lbs/day	$/lb		
Polymer	35	$2.50	$	31,900
Ferric	300	$0.25	$	27,400

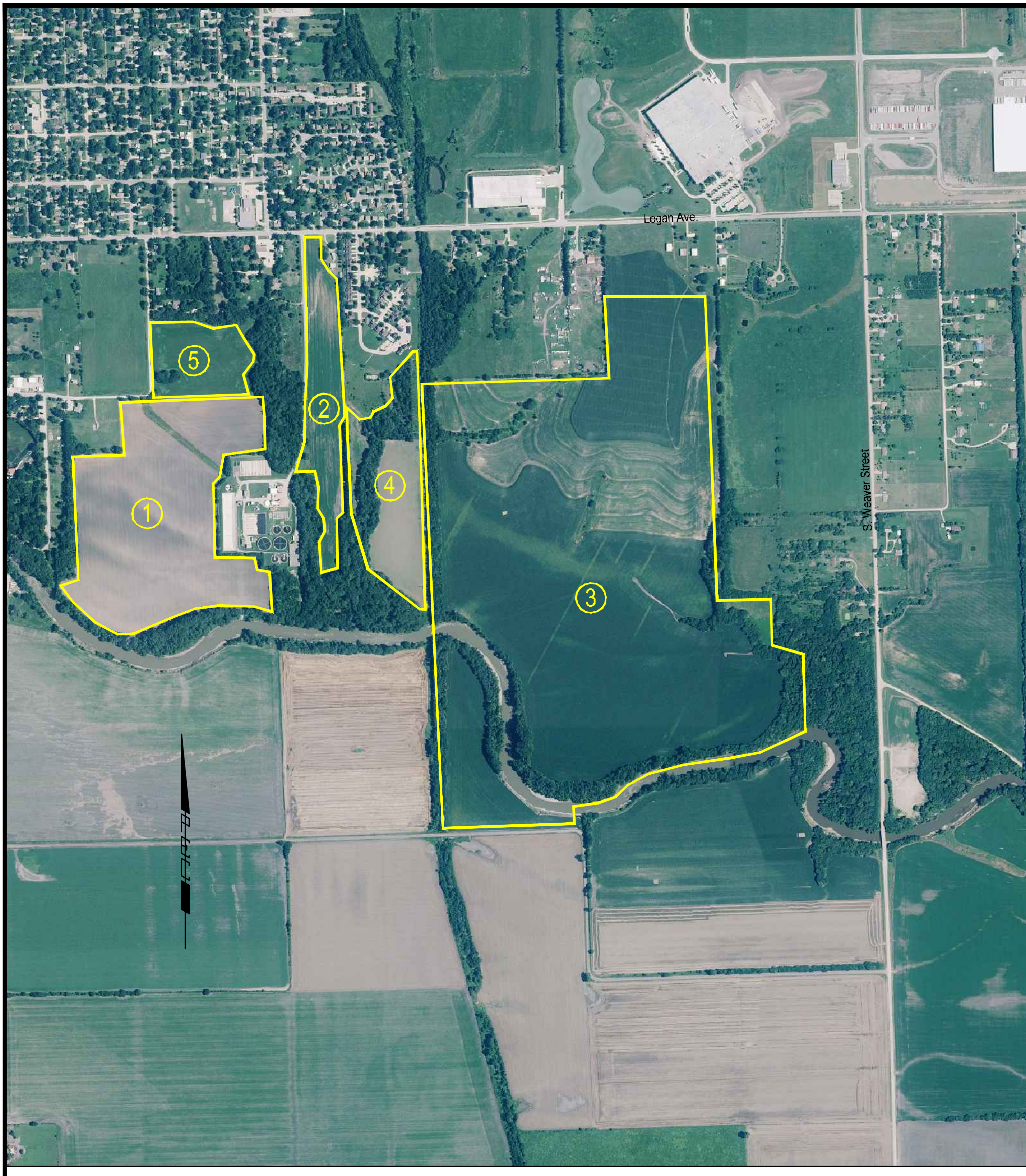
Staff

People	$/hr	hrs/wk		
8	28	40	$	466,000

Sludge Disposal	$	230,000
Maintenance	$	175,000
Supplies	$	30,000
Laboratory	$	30,000
Total=	$	1,522,000

Appendix E

Potential Beneficial Reuse Options



PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
303 SOUTH TOPEKA WICHITA, KS 67202
316-262-2691 www.pec1.com

CITY OF EMPORIA, KANSAS
POTENTIAL BENEFICIAL REUSE
ON AGRICULTURAL LAND
FIGURE NO. 4

PEC

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CITY OF EMPORIA, KANSAS
POTENTIAL BENEFICIAL REUSE
END USERS
FIGURE NO. 5